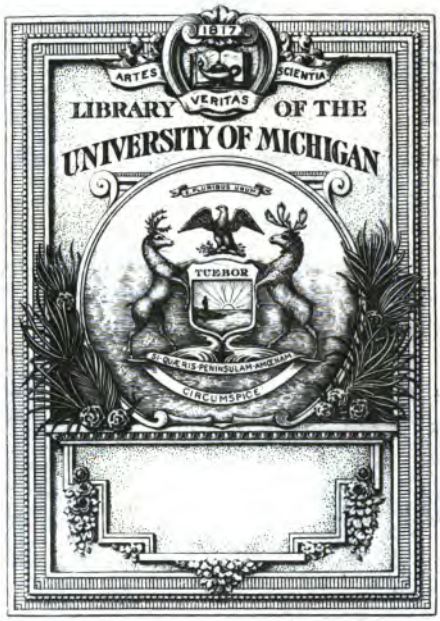
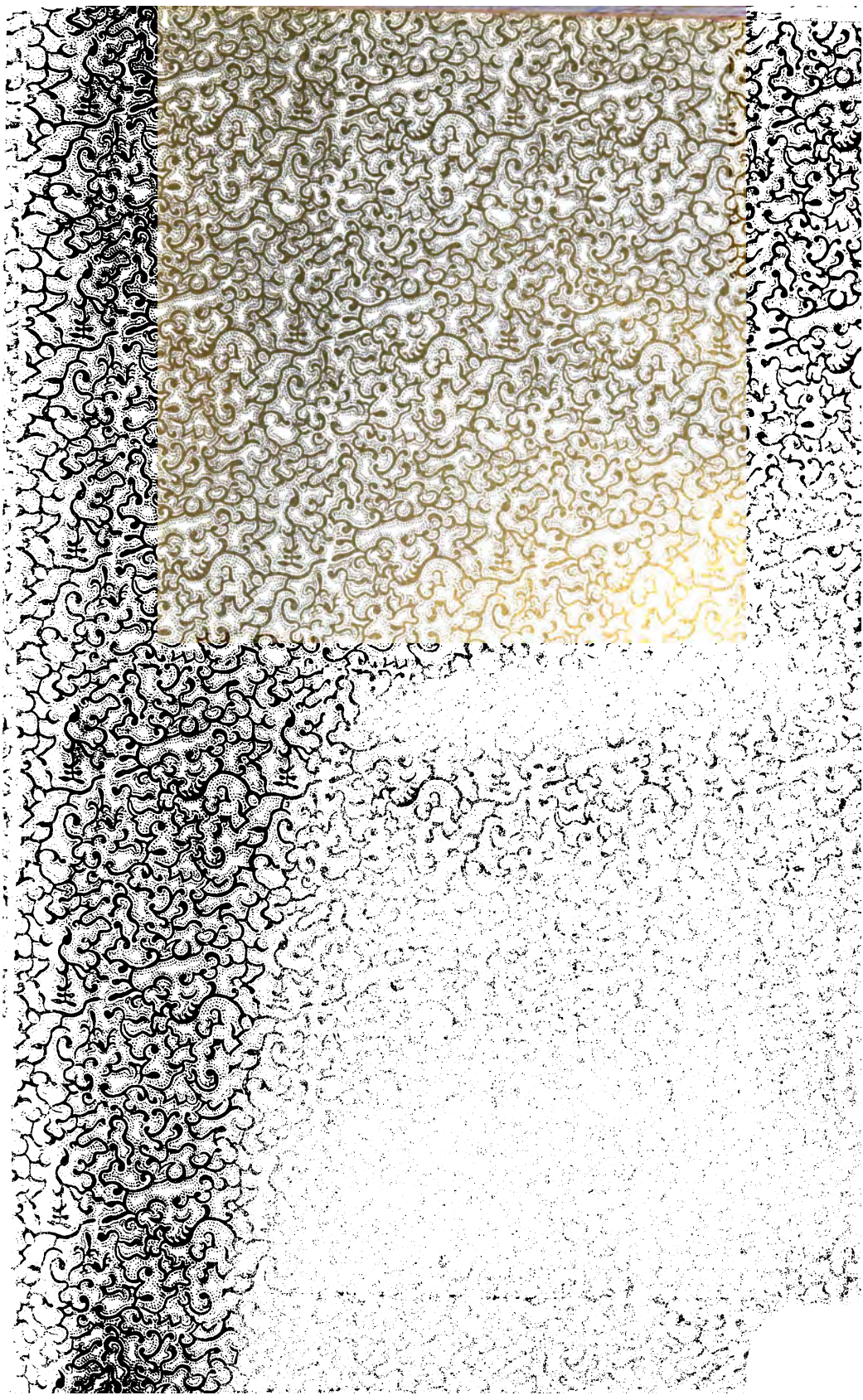




Index
RRS Alaska

64TH CONGRESS, 1st Session } HOUSE OF REPRESENTATIVES { DOCUMENT 610, PART 2

ALASKAN ENGINEERING COMMISSION

REPORTS

OF THE

ALASKAN ENGINEERING COMMISSION

FOR

THE PERIOD FROM MARCH 12, 1914
TO DECEMBER 31, 1915

(MAPS IN PORTFOLIO)

WASHINGTON
GOVERNMENT PRINTING OFFICE
1916

CONCURRENT RESOLUTION.

HOUSE OF REPRESENTATIVES,
February 3, 1916.

Resolved by the House of Representatives (the Senate concurring), That the reports of the Alaskan Engineering Commission, in two volumes, for the period from March 12, 1914, to December 31, 1915, inclusive, together with accompanying maps, charts, and profiles, be printed as a House document, and that 6,000 additional copies be printed, of which 3,000 copies shall be for the use of the House of Representatives, 1,500 copies for the use of the Senate, and 1,500 copies for the use of the commission.

LETTER OF TRANSMITTAL.

THE WHITE HOUSE, *January 19, 1916.*

To the Senate and House of Representatives:

I transmit herewith, for the consideration of the Congress, reports of the Alaskan Engineering Commission, in two volumes, for the period from March 12, 1914, the date of the approval of the Alaskan railroad act (38 Stat., 305), to December 31, 1915, inclusive, together with accompanying maps, charts, and profiles.

WOODROW WILSON.

LETTER OF SUBMITTAL.

ALASKAN ENGINEERING COMMISSION,
Washington, D. C., February 11, 1915.

The PRESIDENT.

SIR: I have the honor to transmit herewith the report of the Alaskan Engineering Commission, together with maps, charts, and profiles.

Very respectfully,

WM. C. EDES, *Chairman.*
(For the Commission.)

CONTENTS.

ILLUSTRATIONS.

PLATES AND FIGURES IN TEXT.

MAPS IN SEPARATE CASE.

MAP I. Index to detailed preliminary surveys for proposed Government railroad.
Ia. General map of Alaska showing preliminary surveys for proposed Government railroad.
II. Map of preliminary surveys, Seward to Turnagain Arm.
III. Map of preliminary surveys, Passage Canal to Ship Creek summit.
IV. Map of preliminary surveys, Ship Creek summit to Knik Wagon Road, and Matanuska Junction to Chickaloon.
V. Map of preliminary surveys, Knik Wagon Road to Talkeetna River, Susitna Valley.
VI. Map of preliminary surveys, Talkeetna River to Broad Pass.
VII. Map of preliminary surveys, Broad Pass to Nenana (Tanana River).
VIII. Map of preliminary surveys, Nenana (Tanana River) to Fairbanks.
IX. Map of routes surveyed or examined, Cordova to Katalla Junction, Bering River coal fields, and Controller Bay.
X. Map of route, Chitina to Fairbanks.
Xa. Profile of route, Chitina to Fairbanks.
XI. Map of preliminary survey, Chitina to mile 72, Chitina-Matanuska Line.
XIa. Profile of route, mile 72 to Matanuska coal fields, Chitina-Matanuska Line.
XII. Map of reconnoissance of Kuskokwim Branch, Willow Creek to Iditarod.
XIIa. Profile of Kuskokwim Branch, Willow Creek to Iditarod.
XIII. Detail map of Ship Creek.
XIV. Detail map of Passage Canal.
XV. Map of Alaska showing route of proposed Government railroad system from Seward to Fairbanks, including Matanuska Coal Branch.
XVI. Map showing adopted line from Anchorage to Chickaloon (Matanuska coal fields) and constructed line, Anchorage to Matanuska River.
XVII. Soil map of Cook Inlet-Susitna region.
XVIII. Soil map of Yukon-Tanana region.

REPORT OF ALASKAN ENGINEERING COMMISSION.

COVERING PERIOD FROM MARCH 12, 1914, TO JANUARY 31, 1915.

AUTHORITY UNDER WHICH COMMISSION ACTED.

By act of Congress, approved March 12, 1914, entitled: "An act to authorize the President of the United States to locate, construct, and operate railroads in the Territory of Alaska, and for other purposes," the President was empowered to act as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States is hereby empowered, authorized, and directed to adopt and use a name by which to designate the railroad or railroads and properties to be located, owned, acquired, or operated under the authority of this act; to employ such officers, agents, or agencies in his discretion, as may be necessary to enable him to carry out the purposes of this act: To authorize and require such officers, agents, or agencies to perform any or all the duties imposed upon him by the terms of this act; to fix the compensation of all officers, agents, or employees appointed or designated by him; to designate and cause to be located a route or routes for a line or lines of railroad in the Territory of Alaska not to exceed in the aggregate one thousand miles, to be so located as to connect one or more of the open Pacific Ocean harbors on the southern coast of Alaska with the navigable waters in the interior of Alaska, and with a coal field or fields so as best to aid in the development of the agricultural and mineral or other resources of Alaska, and the settlement of the public lands therein, and so as to provide transportation of coal for the Army and Navy, transportation of troops, arms, munitions of war, the mails, and for other governmental and public uses, and for the transportation of passengers and property.

(See Appendix A.)

Authority is likewise vested in the President to acquire existing railroad lines, wharves, terminals, etc., either by purchase or condemnation.

Further the act states:

That it is the intent and purpose of Congress through this act to authorize and empower the President of the United States, and he is hereby authorized and empowered, through such officers, agents, or agencies, as he may appoint or employ, to do all necessary acts and things in addition to those specially authorized in this act to enable him to accomplish the purposes and objects of this act.

Further, it is stated—

That the cost of this work authorized by this act shall not exceed $35,000,000, and in executing the authority granted by this act the President shall not expend nor obligate the United States to expend more than the said sum; and there is hereby appropriated, out of any money in the Treasury not otherwise appropriated, the sum of $1,000,000, to be used for carrying out the provisions of this act, to continue available until expended.

The President, May 2, addressed the Secretary of the Interior, as follows:

To the SECRETARY OF THE INTERIOR:

Pursuant to the provisions of the act approved March 12, 1914, providing for the construction and operation of railroads in the Territory of Alaska, I hereby direct you to proceed with the surveying of routes for said railroads and confer upon you the power and authority to do any and all acts necessary thereto.

WOODROW WILSON.

The Alaskan Engineering Commission was created by presidential appointment, the members named for service thereon being William C. Edes, chairman; Frederick Mears and Thomas Riggs, jr., members.

On May 8, 1914, the following instructions were received from the Secretary of the Interior:

Agreeable to the wishes of the President, and by his direction, I take this occasion to formally authorize the Alaskan Engineering Commission to select and appoint its assistants for the work in hand, to purchase the necessary supplies and equipment, to order travel and subsistence for all employees of the commission, and to proceed to the field at the earliest practicable date. I desire that a record of appointments or employments made by the commission be furnished this office, in order that a complete service record may be maintained here.

WORK TO BE COVERED DURING THE SEASON OF 1914.

In order to accomplish the objects set forth in the act of Congress, it was necessary to investigate two general routes from the coast to the interior of Alaska, namely, the eastern route, starting from Cordova or Valdez and extending northward via the Copper River, Tonsina River, Delta River, and Tanana Valley to the vicinity of Fairbanks, and the western route, starting from Portage Bay or Seward and following along the shores of Turnagain and Knik Arms, thence northward through the Susitna Valley and over Broad Pass and down the Nenana River to its junction with the Tanana, and thence by one of several routes to the vicinity of Fairbanks. These routes are described more at length in another portion of this report.

To make a detailed survey over both routes in one season was more than could well be accomplished, especially as it was deemed necessary for the members of the commission to give much individual attention to the field work. While considerable data was available over both routes, least was known about the western. The Government wagon road leading from Valdez to Fairbanks and the road from Chitina north follow in near proximity to the eastern route, thus enabling one to get a pretty close idea of the same. It was therefore decided that the commission should devote its energies for this season to making a careful preliminary survey and estimate of the western route, with a branch therefrom to the Matanuska coal fields; to survey from Chitina (on the eastern route) to the Matanuska coal fields, there being little information on this route; and to a reconnoissance from the western route into the Kuskowim and Iditarod districts, as this had never been covered with railroad construction in view.

It was also decided that members of the commission should make an examination to determine the most feasible plan of getting the Bering River coal to the coast and should also make an investigation of the various harbors proposed for terminals. It was decided, in order to expedite matters in making surveys of the western route, that it should be divided into three districts, each under the general administrative supervision of a member of the commission, who should locate the different field parties on his section and give them directions as to how to proceed with their work.

The first district covers the region south of Knik Arm, the second extends northward to Broad Pass, and the third covers the section north of Broad Pass.

With these objects in view, organization for the work was begun.

ORGANIZATION.

After some days spent in Washington, during which time a few technical men were engaged, a disbursing officer and chief clerk appointed, and other matters of organization attended to, including the purchase of surveying instruments, the commission decided that the work could be expedited by going to Seattle, there to complete the organization, employ the additional men required, and purchase and ship to Alaska the necessary supplies and equipment.

The commission arrived in Seattle May 22, offices were rented, and the necessary machinery set in motion to accomplish the desired results.

It was realized that the working season in Alaska was very short and that it was necessary to move quickly. A large amount of work had been laid out for the summer. In order to carry on surveys in the interior of Alaska in the most economical manner it is advisable to transport supplies by sled over the snow in winter, "caching" them at frequent intervals for future use, rather than to pack them over the soft ground in the summer season by horse or mule train. It being too late in the season for the former method, it was necessary to organize an expensive packing outfit. Before leaving Washington two men had been dispatched to the Northwestern States to purchase horses, and 128 good animals had been secured.

Eleven parties, each under the direction of a competent engineer, were organized and intrusted with the following duties:

Party No. 1: To make a survey and valuation of the Alaska Northern Railroad, and try some alternative routes along the Kenai Peninsula.

Party No. 2: To make a careful topographical survey in the vicinity of Passage Canal.

Party No. 3: To survey from Passage Canal north for about 65 miles.

Parties Nós. 4, 5, and 6: To cover the remainder of the distance to Broad Pass, with a branch to the Matanuska coal fields.

Parties Nos. 7, 8, and 9: To cover the country north of Broad Pass.

Party No. 10: Was to make the survey from Chitina to the Matanuska coal fields.

Party No. 11: To make a reconnoissance from the Susitna Valley to the Kuskokwim and Iditarod country.

Parties 1, 3, 4, 5, 6, 7, 8, 9, and 10, known as locating parties, were each under the charge of a skilled locating engineer; party 2 under the charge of a skilled topographer; and party 11 under the charge of an engineer of large experience in reconnoissance work.

The locating parties, in addition to the engineer in charge, were composed of an assistant engineer, transit man, leveler, chainman, rodman, axmen, cook, and cook's assistant, and were supplied with an adequate pack train.

These parties varied in size according to the country to be traversed and the number of axmen and packers required. In general, they were composed of from 15 to 20 men.

Party No. 2 had, in addition to the engineer in charge, six men, and party No. 11, six men.

With the exception of party No. 10, and the two parties later organized, and many of the axmen who were hired in Alaska, these parties were largely made up in Seattle. Many men were examined as to their qualifications, and from a very large number of applications the required number were selected.

Following the purchase of camp equipment and supplies in Seattle and the assembling of horses and men arrangements were consummated with the steamship companies for transportation to Alaska at the earliest practicable date.

Arrangements were made for the construction of a 50-foot stern-wheel power boat, equipped with 50 horsepower gas engine, for use in the shallow waters of the Susitna River and tributaries. Through the courtesy of Mr. O. H. Tittmann, commissioner of the Alaskan boundary survey, the commission secured the temporary transfer of the survey power freight boat *Midnight Sun* for use in the Nenana and Tanana Rivers.

Party No. 10 had a large territory to cover, and as the commission was able to secure the services of a locating engineer of large experience at Valdez it was deemed advisable to organize the party there and purchase the necessary supplies and pack animals. Instructions to this end were given by telegraph on May 27, and on June 1 the party left Valdez for Chitina, preparatory to taking up the work assigned to them.

CONDUCT OF SURVEYS.

In order to best facilitate the work in Alaska, two main bases of supplies were selected, one at Ship Creek, on Cooks Inlet, and one at Fairbanks, in the interior of Alaska and at the northern end of the route to be surveyed.

Ship Creek, or Knik Anchorage, as it is sometimes called, is situated on Knik Arm of Cook Inlet, about 20 miles south of the little settlement of Knik. It is at the head of navigation for ocean-going steamers. At this point transfer of passengers and freight is made to launches and barges and thence transported to Knik, to points on Turnagain Arm, or up the Susitna River. It is within about 4 miles of the main line of survey of the western route, and is therefore a very favorable point for the distribution of supplies. At Ship Creek was established the headquarters camp. As Fairbanks is the only town of size in the interior within reasonable distance of the work, it was selected as the distributing point for that region. It was decided that it was more expedient to purchase most of the supplies required by the parties working in the northern section at Fairbanks. It would have resulted in delay and additional expense if these supplies had been purchased in Seattle and shipped from that point via the Skagway-Yukon route. The supplies for party No. 10 were also purchased in Alaska, as this party started operations from Chitina before supplies from Seattle could reach them. The supplies for all other parties were secured in Seattle, including

a small amount landed at Seward for the use of the parties operating along the line of the Alaska Northern Railroad.

On May 26 the steamship *Dirigo* left Seattle, having on board 5 men, 20 horses, lumber, and supplies, to establish the headquarters camp at Ship Creek. They arrived at their destination on June 6, and with some local help proceeded to erect some wooden buildings for the use of the commission, and corrals for the horses. Considerable land had to be cleared for this purpose.

On May 29 party No. 2 left Seattle for Passage Canal on the steamer *Alameda*, arriving at their destination June 6. On the same steamer was the assistant master of transportation and 2 packers in charge of 18 horses destined for Fairbanks via Skagway and White Horse.

On June 3 a member of the commission, with 37 men, left Seattle on the steamer *Dolphin* for Skagway, thence by the White Pass and Yukon route for Fairbanks and vicinity. This comprised the nucleus of parties Nos. 7, 8, and 9, which were to cover the country north of Broad Pass.

They arrived at the mouth of the Nenana River on the Tanana River on June 15. Parties Nos. 7 and 9 were unloaded. Party No. 8 disembarked at Fairbanks on the 16th. The parties were recruited to their full strength and necessary additional horses to the number of 44 purchased. Party No. 7 left Nenana for Broad Pass as soon as fully supplied with men, horses, and provisions, on June 20. Party No. 8 was in the field on June 20.

To survey alternate routes from Nenana to Fairbanks, two additional parties were organized and put in charge of assistant engineers promoted in the field. One route to be surveyed was from the Tanana River Crossing, near Nenana, up Goldstream Creek to Fairbanks. The other route followed along the south side of the Tanana River, from Nenana to the upper Tanana Crossing, near Chena. These two parties were organized and equipped locally in Fairbanks. They were at work by June 23. A pack train of 11 horses was hired for the Goldstream party, while the party south of the Tanana was served by launch.

One 50-foot stern-wheel launch, with cargo barge, was lent to the commission for the season by the commissioner of the Alaskan boundary survey. The launch was used for transporting supplies and camps on the Nenana and Tanana Rivers.

On June 5 and 6 the remaining six parties, viz, 1, 3, 4, 5, 6, and 11, with 91 horses and a large amount of supplies for the headquarters camp at Ship Creek, left Seattle on the steamers *Admiral Sampson* and *Northwestern*. Accompanying them were two members of the commission.

Party No. 6, consisting of 13 men and 38 horses, disembarked at Cordova on June 12 for their trip to Broad Pass.

Party No. 1, consisting of 25 men, disembarked at Seward June 13. This party was divided into two sections, one taking up the valuation of the Alaska Northern Railroad, and the other making some surveys looking to possible grade reductions on that line.

Parties 3, 4, 5, and 11 continued on to Ship Creek, where they disembarked on June 15. The next two days were largely spent in getting supplies and horses ashore.

All supplies arriving at Ship Creek Anchorage have to be lightered ashore, a distance of about a mile, and then transferred a short distance up the bank to the camp site. The tidal range being over 30 feet, this can only be accomplished at certain periods.

Available for their purposes the commission had one steam navy launch, transferred from the Bureau of Mines, together with a large barge, and numerous gasoline launches and barges belonging to private parties.

Additional help was put on the erection of buildings, and the heads of the parties were engaged in getting their outfit and equipment together preparatory to starting work. It was determined to start parties 3 and 4 at a summit about 4 miles east of the headquarters camp, this being decided as the proper place for the main-line survey to pass through. Party No. 3 was to run a preliminary line south to Passage Canal, and party No. 4 was to run a line northward toward Knik wagon road and a branch line to the Matanuska coal fields. Party No. 5 was to start at the northerly end of party No. 4's division, a few miles north of Knik Arm, and work northward until they met party No. 6, working south from Broad Pass. Party No. 3 began work June 18, and parties Nos. 4 and 5 on June 19 and 21, respectively.

On June 18 party No. 11 left Ship Creek and crossed over to the town of Knik. On June 20 they left Knik and followed the old trail to the mouth of Willow Creek, which they made the starting point for the reconnoissance to the Kuskokwim and the Iditarod Rivers.

All parties were supplied with the necessary pack trains and equipment.

The instructions given the locating engineers were to run a careful preliminary line over the district assigned to them, taking detailed topography for some distance on either side of the line. Maps on a scale of 1 inch equals 400 feet were to be made and a location projected thereon. This for the purpose of making a more accurate estimate than could be made from the preliminary line. As far as time permitted, the projected location was to be marked out on the ground. A general map on a scale of 1 inch equals 5,000 feet was to be made and profiles of preliminary location and projected location lines, on a scale of 400 feet to the inch, horizontal, and 20 feet to the inch, vertical, were to be prepared. Engineers were instructed to make careful notes of the physical characteristics of the country through which they worked, the character of the soil, probable resources, and any other items of interest. Reports were to be made as often as possible to the headquarters camp at Ship Creek, where were located the general office forces.

Party No. 11 started from the main line near Willow Creek, and carried a reconnoissance into the Kuskokwim and Iditarod country. They were to determine if there was a practicable railroad route into that section, and make an approximate estimate of the grades and cost of construction. They were to submit a report regarding the resources and probable future development of the country, and were to push through to the Yukon River and return to Seattle via St. Michaels.

On June 18, a member of the commission, with one companion and a small pack outfit, left Ship Creek to make a general reconnoissance

of the country between that point and Broad Pass. At the latter point he was to join the member who went north via Skagway with parties 7, 8, and 9. Together they were to inspect the country in the Broad Pass and Fairbanks region, and later, returning via the Government wagon road to Valdez, were to inspect the country which would be passed through by the eastern or Copper River route. They were also to inspect the harbor of Controller Bay and the possible route to the Bering River coal fields; the Copper River & Northwestern Railroad, with its possible branch to the Bering coal fields; and the harbors of Cordova and Valdez. The third member of the commission was to make headquarters at Ship Creek and supervise the work south of there and the line to the Matanuska coal fields, and also, as far as possible, to participate in the examination of various harbors and existing railroads. With the work thus outlined, the various parties accomplished the following results:

RESULTS ACCOMPLISHED BY VARIOUS PARTIES.

The division of party No. 1, delegated to make survey and valuation of the Alaska Northern Railway, began their work at Seward, by making note of the terminal facilities of the road, the amount and condition of the equipment, size and condition of the buildings, etc. There were available, for the use of the party, the plans and profiles of the line as originally constructed, together with numerous notes of the amount of material removed in the construction, material placed in structures, etc. The line was measured over carefully and notes taken of condition of roadbed and structures, the amount of material, such as rails and ties, at various points along the line, and a valuation placed on same. In places where the original notes were inadequate, cross sections were taken to determine the amount of material removed, and measurements were taken of the structures.

The bridge engineer of the commission also spent considerable time going over all the structures and making an estimate as to the expense of putting the road in proper operating condition. This work covered the entire length of the line from Seward to Kern Creek, a distance of 70.8 miles. Notes were also taken of material on hand and work done for several miles beyond the end of track at Kern Creek, this portion being partially graded in places. Field work was begun June 15 and completed October 6. A few men were retained temporarily until the office work was completed.

The statement has often been made that the Alaska Northern Railroad, from mile 48 to mile 58, was erroneously located, and that much better results could have been obtained, leaving the present line near mile 48 and following the west wall of the valley, with side-hill support on a grade of 1.1 to 1.2 per cent, and reaching the present line again near mile 58. Also, that a survey would show an economy in abandoning the present location along this stretch in favor of the one suggested, when traffic had reached warranted proportions. In order to definitely decide this matter, the main portion of party No. 1 was directed to make the necessary surveys. Starting near mile 45, of the Alaska Northern Railroad, a preliminary line, followed by a definite location on the ground, was run, covering a distance of 18.3 miles. This survey traversed an exceedingly rough

and difficult country and progress was necessarily slow. This work was begun on June 30 and completed September 30. The party was then moved to Ship Creek and ran a location from the main-line summit opposite that point southward over the preliminary run by party No. 3, a distance of 18.44 miles. They also located a branch line from the main line to Ship Creek, a distance of 4.19 miles. The chief of party made reconnoissance and report covering the so-called Johnson Pass route from near mile 34 on the Alaska Northern Railroad to near mile 64; also a reconnoissance of the Moose Pass route and possible Moose Pass spur, commencing on mile 29 on the Alaska Northern Railroad. Some short preliminary surveys were made to certain reputed low passes near mile 12 of the Alaska Northern Railroad. Party No. 1 left Ship Creek November 2 for Seattle.

Party No. 2 commenced operating June 6 at Passage Canal and made a very complete contour map of that vicinity. This work was extended across the mountains to Turnagain Arm. A great deal of rainy weather was experienced on this survey. On September 30 this party was disbanded, with the exception of the chief topographer and four men, who proceeded to Ship Creek and made a contour map of the vicinity.

Party No. 3 ran a preliminary line from the summit opposite Ship Creek to Passage Canal, a distance of 64.55 miles. Then starting at Passage Canal, projected and definitely located a line on the ground, a distance of 38.97 miles following this preliminary. This leaves a distance of 7.24 miles between the location made by party No. 3 and that made by party No. 1, south from Ship Creek summit. Party No. 3 left Ship Creek for Seattle November 2.

Party No. 4, starting at the summit near Ship Creek, ran a preliminary line northward, a distance of 39.1 miles, to the crossing of the wagon road leading from Knik to the Willow Creek mines. A location was projected over this line, and, starting at Ship Creek summit, 10.5 miles were located on the ground. A preliminary line 38.45 miles long was run from Chickaloon to the Matanuska coal fields, down the Chickaloon and Matanuska Rivers to a point on the main-line survey, a little north of the Matanuska River. A location was projected on this line.

Party No. 5, starting at the Knik wagon road, 14.75 miles north from the town of Knik, reached their territory on the 19th day of June and ran a preliminary line in a northwesterly direction around the foot of Bald Mountain, thence in a general northerly direction up the Susitna Valley to a point 15 miles above the crossing of the Talkeetna River, a few miles above its confluence with the Susitna. They completed 81.5 miles of preliminary line during the season, on which location was projected but not run. The party ended their work on October 8, tying in with the preliminary line produced southward from Broad Pass.

Party No. 6 arrived at Cordova on June 13 and proceeded to Chitina over the Copper River & Northwestern Railroad, where they engaged several four-horse teams to haul their outfit over the Government wagon road and thereby relieve the pack horses. They left Chitina on June 17 and arrived at Meiers road house, near the summit of the Alaska Range, on June 24. On June 25 the party left Meiers road house with about 8,000 pounds of equipment and supplies, carried by 36 pack animals, and proceeded in a westerly

direction along the Alaska Range to Broad Pass, where they arrived on July 9. The total distance from Chitina to Broad Pass (240 miles) was covered in 23 days. On July 11 surveys were begun in Broad Pass at the initial point used by party No. 7, and a line was extended southward to a point 15 miles above Talkeetna, where it tied in with the line produced by party No. 5, from Knik wagon road, on October 10. The party ran 71 miles of preliminary line and projected and located on the ground 32 miles. A location was projected for the balance of the line, but not run in.

Party No. 7 left Seattle on June 3 and, going in via Skagway and the Yukon River, arrived at Nenana, a town at the confluence of the Nenana and Tanana Rivers, on June 15. The party proceeded up the east bank of the Nenana River, carrying the necessary outfit and supplies by pack animals. They reached Broad Pass on July 3, where they immediately commenced operations. They produced a preliminary line northward through Broad Pass and down Jack River and crossed to the east side of the Nenana River at a point a few miles above the mouth of Jack River. They carried the preliminary line down the east bank of the Nenana River to the south end of the Nenana Canyon, at which point they again crossed the Nenana River and carried their preliminary line down the west side. They finished work at a point opposite the mouth of the Healy Fork on September 3, when they tied in with the field work of party No. 9. They ran 71.5 miles of preliminary line on the ground. A location was projected for 51.54 miles, but not run in.

Party No. 8 came in via Skagway and Yukon route and arrived at Fairbanks on June 15. On June 16 they made camp at Chena, 9 miles from Fairbanks, and commenced running a preliminary line down the north bank of the Tanana River to Nenana, which point was reached on July 18. Considerable time was spent in the vicinity of Nenana investigating the several crossings of the Tanana River, and the work of this party on this section of the line was completed on July 27. They removed to Fairbanks, and on August 2 made a reconnoissance of the crossings of the Tanana River on a line due south toward the Wood River. This line was continued in one tangent for about 8 miles until August 9, when it was abandoned. On August 10 the party broke camp on the Tanana and moved to the Nenana, where they commenced running a preliminary line up the east bank of the Nenana River. They completed this work and tied in with the preliminary line staked by party No. 9 on August 31. During the season they ran a total of 84 miles of preliminary line and worked out a projected location for 30.25 miles.

Party No. 9 left Seattle on June 3 and proceeded over the same route as party No. 7, arriving at Nenana on June 15. They proceeded up the east bank of the Nenana River and worked for several weeks in the vicinity of Healy Fork and Hoseanna Creek in an effort to find some low passes in the Alaska Range which would permit of a more direct line being run from Broad Pass to Fairbanks. Failing in this, they started work on August 8 at Thirty Mile Road House (30 miles north of Nenana) and produced a preliminary line up the east bank of the Nenana River to a point near Moose Creek, where they crossed to the west bank and tied in with the preliminary

line produced northward from Broad Pass by party No. 7. They ran 58.6 miles of preliminary line; 30.11 miles of location were projected, but not run in.

The South Bank party was organized at Fairbanks and put into the field at Chena on June 23 to run out a preliminary line on the south bank of the Tanana River between the town of Nenana and the town of Chena, paralleling the work of party No. 8 on the opposite side of the river. They ran a total distance of preliminary line of 39.44 miles and finished work on August 12.

The Goldstream party was organized at Fairbanks and started on June 24 to run a preliminary line from a point on the Tanana Valley Railroad (about 7 miles from Fairbanks) down the Valley of Goldstream to connect with the proposed crossing of the Nenana River near Nenana. They completed work at the latter point on September 3, where they tied in with the preliminary line staked out by party No. 8. They ran a total of 47.56 miles of preliminary line on the ground, from which a projected location was made.

Party No. 10 started from Chitina on June 3 and ran a preliminary line northward along the Copper River, and thence westwardly up the Tazlina River to Tahneta Pass, and thence down the Matanuska River to near Chickaloon, in the Matanuska coal fields, where connection was made with the line run by party No. 4. The party completed field work on September 12, having run 165 miles of preliminary line, on which a projected location was made.

Party No. 11 started from Knik on June 20 and proceeded over the old survey pack trail to a point near the mouth of Willow Creek, on the eastern bounds of the Susitna Valley. They crossed the Susitna River and made a reconnoissance westward through the Susitna, Yentna, Skwentna, and Happy River Valleys to the headwaters of the Happy River, in the Alaska Range. They covered the range for 30 miles along its axis, investigating all the passes. They followed the south fork of the Kuskokwim River to Farewell Mountain, thence westerly across the Kuskokwim Basin to McGrath, at the mouth of the Tacotna River. They followed up the Tacotna Valley to the Innoko Divide, and thence by the Tacotna, Moose Creek, and Bonanza Creek Valleys to Iditarod. The party returned to Seattle on October 15. The report of the reconnoissance engineer will be found in Appendix F.

A detailed description of the physical characteristics of the various lines appears later in this report.

In order to avoid delay, it was found convenient to enter into an agreement with the Copper River & Northwestern Railroad to survey a preliminary line from a junction with their tracks at mile 39 leading to the Bering River coal fields via the Lake Charlotte route. An engineering party was put into the field on September 15 and finished work on October 16. They surveyed a line from Katalla Junction across the flats 8.5 miles to connect with an existing survey known as the Whorley (1906) location. The old Whorley line from this junction point east toward the Bering River was then cleared and rechained and new levels were run as far as Martin River. Such work was necessary in order to obtain a reliable map and profile of this line.

PLATE 1.

COPPER RIVER AND NORTHWESTERN RAILWAY WHARF, CORDOVA, ALASKA.

TOWN OF CORDOVA, ALASKA.

EXAMINATION OF ALASKAN RAILROADS.

A list of all railroads in Alaska may be found on page 25 of the Alaska Railroad Commission report, 1912.

The Alaskan Engineering Commission confined its investigations to those railroads which had some direct bearing upon the general routes under consideration, and examined the following:

	Miles.
(A) Copper River & Northwestern Railroad:	
Cordova to Kennicott (standard gauge)	195.0
(B) Alaska Northern Railroad:	
Seward to Kern Creek, a point near the head of Turnagain Arm (standard gauge)	70.8
(C) Tanana Valley Railroad:	
Fairbanks and Chena to Chatanika (narrow gauge)	46.0

(A) THE COPPER RIVER & NORTHWESTERN RAILROAD.

The Copper River & Northwestern Railroad is the most active standard gauge railroad in Alaska. Its construction was undertaken for the purpose of furnishing a suitable means to transfer the output of the great Bonanza copper mine, at Kennicott, 195 miles to the seaboard. While performing certain other functions of a common carrier, in serving the immediate neighborhood, it has remained largely an ore-shipping railroad.

The Copper River & Northwestern Railroad was examined by the commission throughout its length. The first inspection was made in September, the second in October, and the third in November, 1914; and, while a careful examination was made of the road under conditions prevailing at the time, the commission is without proper information as to the maintenance and operating conditions of the winter months. To supply this information, one of the commission's engineers has been sent to Cordova to act as an observer during January, February, and March, 1915.

The railroad has been quite fully described by the Alaska Railroad Commission in their report, on pages 59 to 64, inclusive, and the commission considers it unnecessary to here repeat or elaborate to any great extent upon that information. Only the briefest description of the line is given, to permit of an understanding of the remarks which follow.

Cordova is the terminus of the Copper River & Northwestern Railroad, situated at the head of Orca Inlet, an arm of Orca Bay, Prince William Sound, where the workshops, terminal yards, and general offices of the company are located.

After leaving Cordova the line of the Copper River Railroad skirts the south shore of Eyak Lake and reaches the Sheridan Glacier Flats through a very low saddle southeast of the lake.

It crosses the flats between miles 12 and 19 and reaches the delta of the Copper River at mile 20.

The railroad crosses and recrosses the Copper River with its numerous channels and tributaries, between mile 20 and 49, and then holds the west bank of the river to Chitina, at mile 131. The railroad finally crosses the Copper River at mile 132, in its extension to the Kennecott mines at mile 196. This branch follows up the Chitina River Valley to the mouth of the Nizina River, thence up that stream for about 7 miles to the Kennecott River.

MAXIMUM GRADE.

The grades for this road were laid out to secure a maximum 0.8 per cent compensated grade against northbound traffic and a maximum 0.7 per cent compensated grade against southbound traffic between Cordova and Chitina, 131 miles, and a maximum 2.5 per cent compensated grade against northbound traffic, and 1 per cent compensated grade against southbound traffic between Chitina and McCarthy, mile 191, near Kennecott. It was evidently the intention to operate pusher grades on the last 7 miles near Kennecott, as in this district there were designed 3.47 per cent compensated grades against northbound traffic and 2.5 per cent compensated grades against southbound traffic.

Due to a desire on the part of the management to economize in the later periods of construction, many temporary grades were made use of, and the road is now being operated with about 1 per cent grades in both directions, Cordova to Chitina, and 2.5 per cent grades, Chitina to McCarthy (near Kennecott). Several heavy grades (2 per cent) are also being used in the temporary approaches to some of the permanent bridges, and 4 per cent grades are being used on the temporary crossing of the Copper River at mile 132, to which reference will be made in another part of this report.

An illustration of one of the temporary grades on the Kennecott branch occurs at mile 174. (Pl. 3.)

While these temporary grades do not interfere with operation under present traffic conditions, they would undoubtedly have to be removed if the train movement over these sections was increased.

CURVATURE.

The alignment as originally contemplated provided maximum curves of 12° mile 1 to 95, and 14° mile 95 to 195. In the process of operating and maintaining this road with small forces, little attention has been paid to exact curves and spirals; the track foremen have adjusted the alignment to meet their special conditions, with the result that many curves are now being used approaching 20° to 25°.

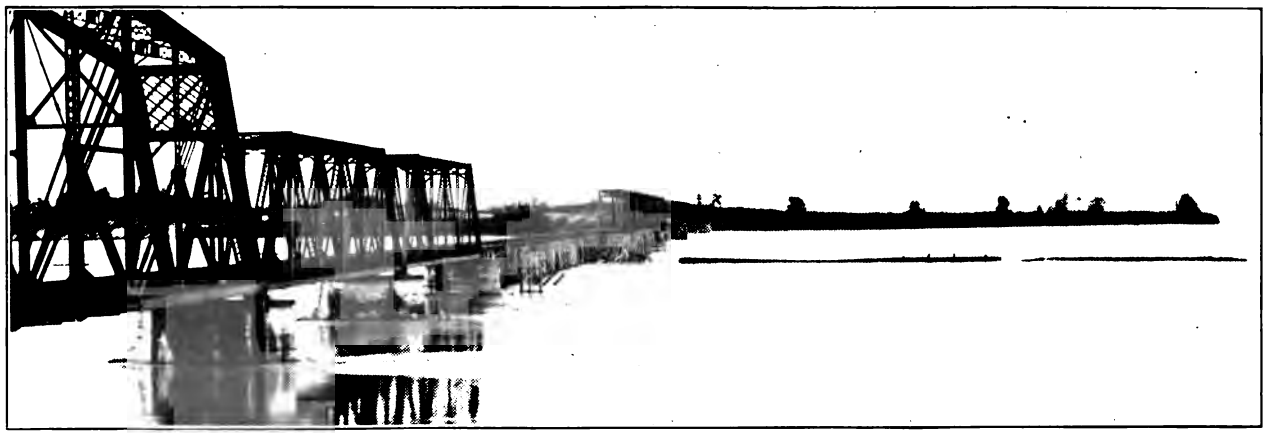
BRIDGES.

Some very excellent and costly bridges have been constructed on the Copper River Railroad. The crossing of the delta of the Copper River required such measures, and the structures are monuments to the designers and builders.

With the large initial outlay on the bridging required in the Copper River section it was not to be expected that costly spans would be placed where they were not immediately necessary. Thus it was that numerous sand bars and stretches of shallow water between the river banks were spanned by wooden pile trestles, and while many of these structures will probably answer all requirements for some time to come, still in many sections they are subject to immediate removal by the flood waters of the Copper River. Prolonged freshets in the river or the breaking of one of the impounded glacial lakes would be sufficient cause to bring about such a result. A concrete example of such an action is seen at bridge 27A. (Pl. 4.)

A. COPPER RIVER RAILROAD, MILE 18.

B. SHOWING SAGS AT BOTH ENDS OF BRIDGE 174–A, COPPER RIVER AND NORTHWESTERN RAILWAY.



A. BRIDGE 27-A, COPPER RIVER AND NORTHWESTERN RAILWAY, SHOWING SECTION WASHED OUT.

B. UPPER END BRIDGE, MILE 34, SHOWING LONG APPROACH TRESTLE.

Bridge 34 also has a long approach trestle to the channel spans. (See pl. 4.)

An inspection of some of the bridges would suggest that some of the permanent work called for by the original plans was omitted. The following scheme was used: A temporary trestle was driven parallel to the true axis of the bridge, and at an elevation slightly lower than the final grade. This false work was used to assist in the erection of the bridge as well as to connect the traffic from both sides of the structure. (Fig. 1 and pl. 5.)

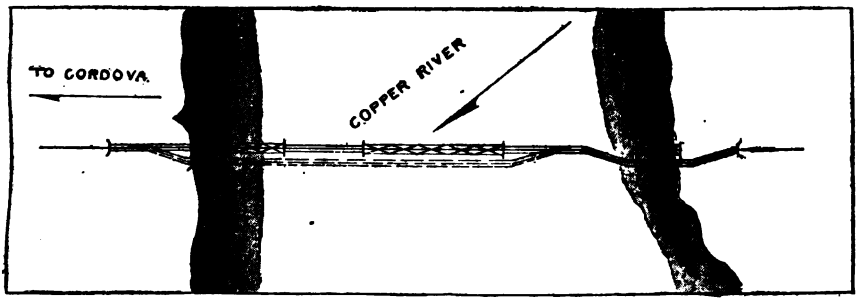


FIGURE 1.—Bridge 27A, Copper River & Northwestern Railway.

These temporary approaches have been retained in many cases and made to serve for the permanent line. This causes short sections of 2 per cent grades and temporary alignment, both of which limit the speed of trains.

The crossing of the Copper River at mile 132, near Chitina, is made on a temporary pile trestle bridge at a low level, with the

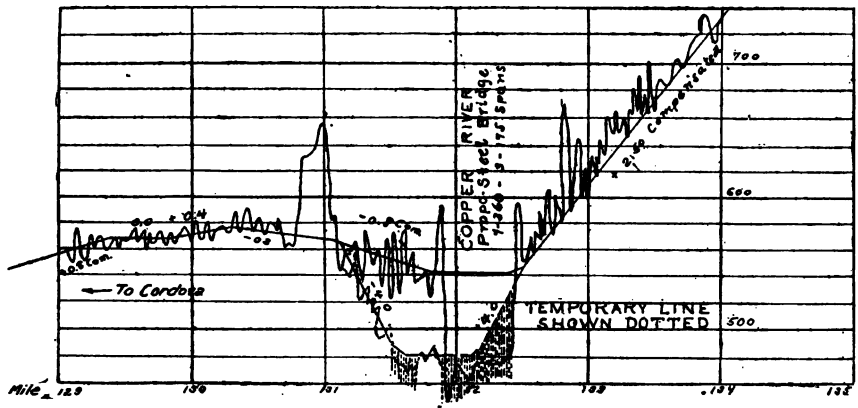


FIGURE 2.—Showing temporary and permanent grades for Copper River Bridge, mile 132.

approaches on 4 per cent grades. A permanent steel bridge at this point would cost about $650,000, and the railroad company considers that it results in economy to replace those portions of the temporary bridge swept away by the spring floods each year rather than pay interest on this heavy investment. The traffic is thus interrupted for about two weeks while the trestle is being redriven. A section of the crossing of the Copper River at mile 132, showing temporary and permanent grades, is given in figure 2, and a photograph of the trestle as it existed in September, 1914, in plate 5.

SNOW.

The snow conditions on certain sections of the road in the Copper River Delta are somewhat serious. The snow in these sections stands several feet deep on the level, and the strong prevailing winds blowing down the Copper River Valley cause drifts to form across the track. In some few sections of the line the train must immediately follow the rotary snowplow in order to secure a clear track, so quickly does the drifting snow fill in the opening made. These conditions make it desirable to attach an extra engine and snowplow to the rear of the train, to make it possible to cut back if the train is blocked ahead. The rotaries work on the road, in an average year, from December 1 to March 1.

Doubtless many of the difficulties from snow could be counteracted or overcome by track elevation through certain sections and the erection of snow fences and snowsheds at other points. The track elevation would place the track above the level of the ground, permitting the wind to blow the snow clear of the track and providing better snowplow action.

The best protection against snowslides, which threaten the track at mile 53, would be a tunnel through the hill at that point. From the information gathered as to the magnitude of this slide in certain years, it would seem advisable to furnish this protection. The photograph, plate 6, shows the snowsheds now provided at this point.

WIND.

The wind moving south from the areas of high pressure in the Alaska Range, through the valley of the Copper River, toward the warmer areas on the south seacoast, are a constant source of trouble during the winter months. In the lower valley the winter winds sometimes reach a velocity of 80 miles an hour, which, coupled with the snow conditions, make operation and maintenance in that district difficult and expensive.

GLACIERS.

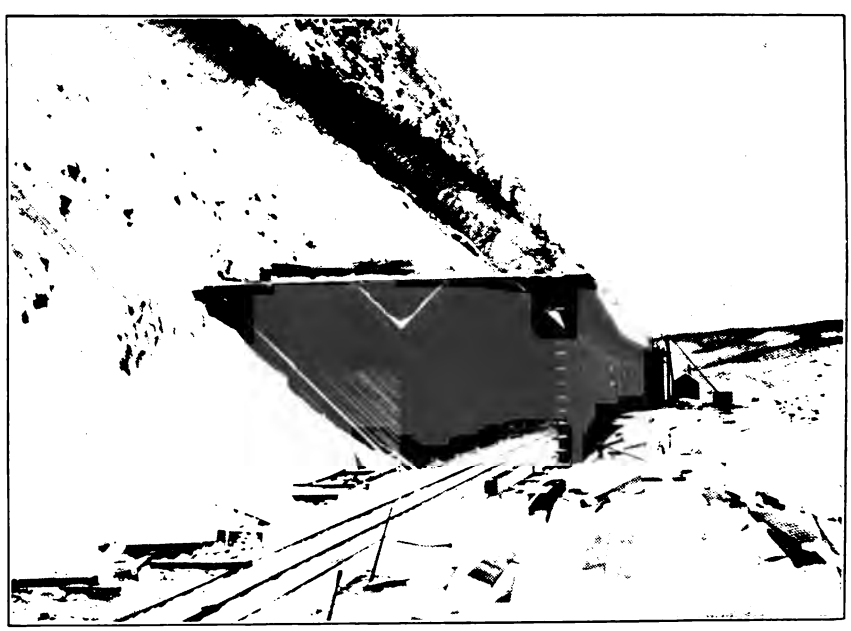
There are several glaciers near the tracks of the Copper River Railroad which are frequently referred to in describing this property. The Childs Glacier lies to the west of the Copper River Railroad, near mile 49, and opposite the long steel bridge spanning the Copper River at that point.

From an operating standpoint the Childs Glacier does not affect the Copper River Railroad. The Copper River acts as a guardian to the railroad in that it takes away the ice from the face of the glacier as fast as it caves off. There are two dangers from this glacier, one is the possibility of the northeast lobe advancing *on the land*, a sufficient distance to destroy the upper end of the steel bridge. (See diagram and photograph showing the relative position of the glacier and the bridge. Pl. 7.)

A. UPPER END OF BRIDGE 27-A.

B. SHOWING TEMPORARY STRUCTURE ACROSS THE COPPER RIVER AT MILE 132.

A. ROTARY SNOW PLOW OPERATING ON THE COPPER RIVER RAILROAD, PUSHED BY THREE LOCOMOTIVES.



B. SHOWING SNOW SHEDS, COPPER RIVER RAILROAD, MILE 53.

In 1910 and 1911 this lobe advanced a distance of 1,500 feet and attained a position July 12, 1913, as indicated in Plate 7, *B*. It has since receded several hundred feet and has given no further indication of advancing.

The other danger is the remote possibility that the main front of the glacier will advance with sufficient activity to dam the Copper

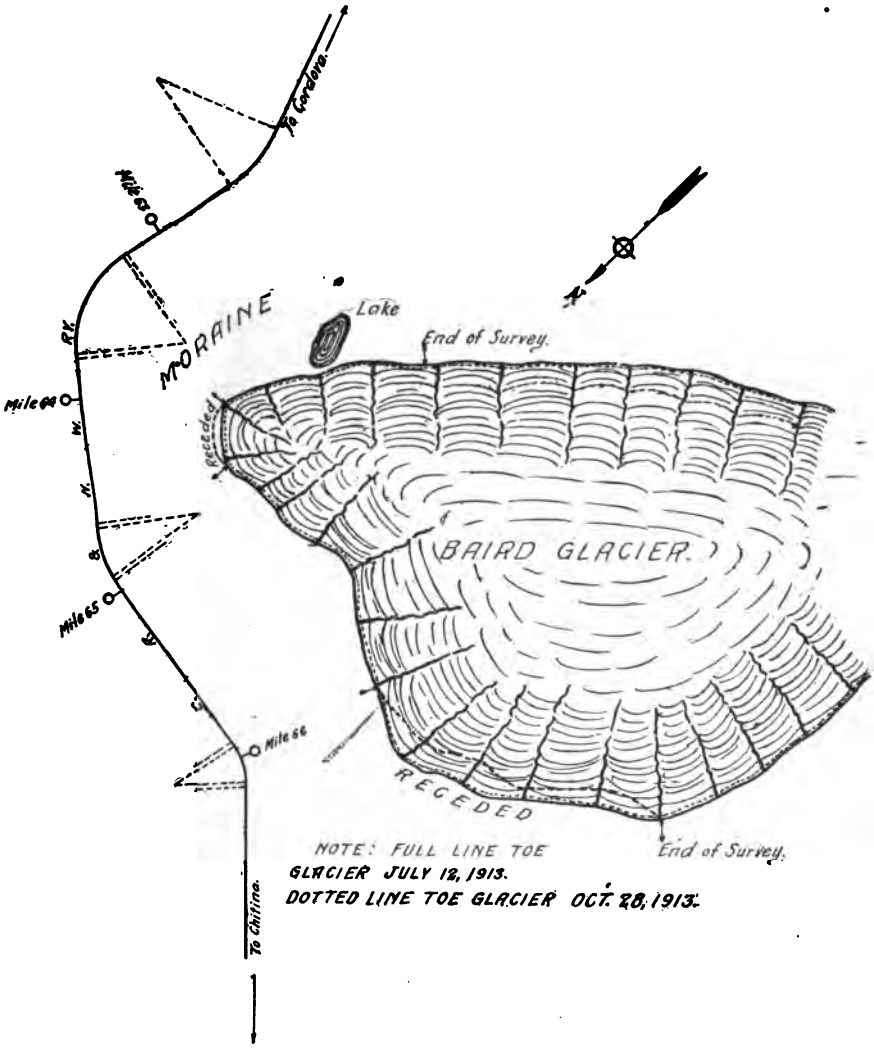


FIGURE 3.—Situation at Baird Glacier, Mile 64, C. R. & N. W. Ry.; approximate scale, 1 inch equals 4,700 feet.

River and cause it to cut through a new channel at some point farther east. If the glacier were relieved from the action of the water along its face it would probably advance a sufficient distance to encroach upon the right of way and destroy the track and bridge.

The Miles Glacier lies on the opposite side of the Copper River Railroad, about due east from the steel bridge. It has advanced and receded short distances each year. The Miles Glacier is much farther removed from the railroad than the Childs Glacier. A severe earthquake might cause either of these glaciers to advance a sufficient distance to destroy the bridge and railroad, but it is believed this is rather a remote possibility.

The commission is without experience in regard to the movement of the Alaskan glaciers and can do no better than to refer to the opinion expressed by the Alaska Railroad Commission on pages 63 and 64 of that report. One of the members of that commission is an eminent geologist of national reputation, and it is believed that his views should be given due weight.

The Copper River Railroad crosses the terminal moraine of the Baird Glacier (now called Allen Glacier) for a distance of six miles (miles 57 to 62). This moraine is covered with earth and crushed rock and supports a dense growth of vegetation. The ice of the glacier is visible only at some distance from the track, and unless the traveler is so advised he will not notice the fact that he is traveling on a glacier. (Pl. 8.)

About 2 miles of this section are underlaid with ice.

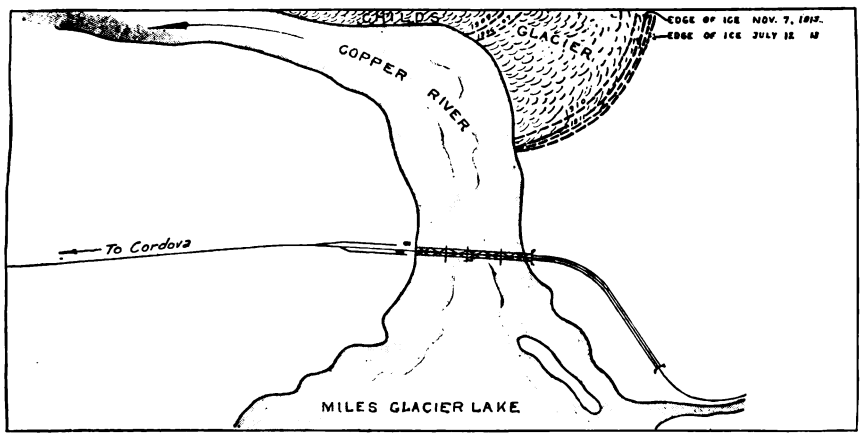
Due to the melting of the ice beneath the gravel and crushed rock, additional maintenance is necessary to keep up the track. In the early days of construction considerable trouble was experienced, but during the past year less than 500 cubic yards were placed. At some points, where the track was formerly laid through a cut, it now lies on top of a shallow fill, the grade of the cut having settled to that extent.

The Baird Glacier at this point seems to have no movement, the difficulty encountered being the settling of the track due to thawing action rather than to any lateral movement. That the Baird Glacier might advance over the terminal moraine toward the river and destroy the railroad is rather a remote possibility.

At the northern end of this section (miles 62 to 66) the line is carried over the discharge waters of the Baird Glacier. Like all of these glacial streams, the channels carrying water are constantly changing, having a tendency to form strong currents carrying driftwood at one or two points, thus taking out the wooden trestles. The swift waters also wash out the embankments here and there, unless properly riprapped with heavy rock. The commission saw an example of this action between miles 65 and 66. (Pl. 9.)

This trouble can be largely overcome by providing suitable openings to carry the flood discharge of the waters and by riprapping the embankment in place to prevent destruction. This work was being done. The commission wishes to call attention to the fact that there is a constant filling-in process going on around these trestles. The glacial waters carry a large amount of sediment, gravel, and débris, particularly in their flood stage, not many years being required to fill in around the track. The only remedy for this condition is to raise the grade of the track, which would require higher embankments and new bridges.

A. VIEW OF STEEL BRIDGE NEAR CHILDS GLACIER, MILE 49, C. R. & N. W. RY., LOOKING SOUTHWEST.



B. SITUATION AT CHILDS GLACIER CROSSING OF COPPER RIVER AT MILE 49.

VIEW OF TRACK, C. R. & N. W. RY., TOE OF MORAINE, BAIRD GLACIER.

While the line of the Copper River & Northwestern Railroad at mile 65 will undoubtedly handle the traffic with its present track for some time to come, the commission is of the opinion that the grade of this track will ultimately have to be raised for the reasons given.

COST OF OPERATION AND MAINTENANCE.

A statement showing the earnings and cost of operation of the Copper River & Northwestern Railroad is contained in Appendix B. The recapitulation of this statement is here given for convenient reference. The figures were secured through the courtesy of the railroad management.

Recapitulation of earnings and operating expenses, Copper River & Northwestern Railroad, Nov. 1, 1911, to June 30, 1914.

	Eight months ended June 30, 1912.	Year ended June 30, 1913.	Year ended June 30, 1914.
Gross revenue	$466,271.38	$433,560.41	$685,452.30
Operating expenses	301,383.43	575,059.85	586,078.46
Net revenue or net deficit (deficit in italics)	164,887.95	*141,499.44*	99,373.84
Licenses and wharf taxes	15,326.44	22,266.40	22,625.55
Actual net revenue or deficit (deficit in italics)	149,561.51	*163,765.84*	76,748.29

Actual net revenue, three periods	$62,543.96
Average annual revenue	23,454.00

NOTE.—The above figures do not include interest charges on capital invested.

TONNAGE STATEMENT.

A statement showing the freight tonnage transferred over the Copper River & Northwestern Railroad is contained in Appendix C. The recapitulation of this statement follows:

	Northbound.		Southbound.		Total tons.	Total ton-miles.
	Kennecott.	Other.	Kennecott.	Other.		
1912	4,360	5,262	19,160	354	29,136	3,575,808
1913	5,331	4,652	12,269	377	22,629	3,600,018
1914 (9 months)	4,153	3,750	8,008	1,042	16,953	2,999,147
Total tons	13,844	13,664	39,437	1,773	68,718	10,174,973

REMARKS.

The commission in writing the above description of the Copper River & Northwestern Railroad has thought it proper to call attention to certain physical features, particularly characteristic of this property, and has omitted until now the reference to the many miles

of standard railroad which is a part of the property. The views in plates 10, 11, and 12 forcibly demonstrate that a workable railroad exists to-day.

The traffic over this road during the months of June, July, August, September, and October, 1914, consisted of the movement of one mixed train, Cordova to Kennecott and return, scheduled to leave at intervals of five or six days, meeting the Alaska Steamship Co.'s boats northbound from Seattle. At infrequent intervals specials were operated for some particular purpose, and the train service was further supplemented by passenger motor car as occasion demanded. This service was increased in November. The rates for this service were high, being 12½ cents per passenger mile, and from 3½ to 14½ cents per ton-mile, compared to the 2, 3, and 4 cent passenger-mile and the 1-cent ton-mile rates common in the United States.

It is conceivable that if the present rates were lowered increased business would result, but whether or not such action would bring about increased earnings or a deficit is largely problematical.

Many of the disadvantageous conditions of the road could be remedied by making certain physical changes.

If increased capital were placed with the Copper River & Northwestern Railroad for the improvement and betterment of maintenance of way there is no doubt but that large economies would result in operation and maintenance. It now takes four engines to operate the snowplow over the line, which service could be satisfactorily performed by two engines of a larger type if proper track elevation and snowshed protection were provided. The temporary bridges could gradually be made over into suitable permanent structures and the present heavy maintenance charges thereby reduced. All of these betterments could be made under traffic without impairing the earning power of the road, but that it would result in large initial expenditures can not be denied. There is a wide variance between the present traffic of one or two round-trip trains per week and the traffic of the future, which will require that the road be double-tracked, as some optimists predict; but, striking a happy medium between these two extremes, it is reasonable to assume that future traffic will require an increase and betterment of present facilities.

(B) THE ALASKA NORTHERN RAILROAD.

BRIEF EARLY HISTORY.

The Alaska Central Railroad, later the Alaska Northern Railroad, was first conceived by certain Seattle capitalists in the year 1903 for the purpose of securing a more direct route from the Pacific Ocean to the interior of Alaska, in the hope of getting a portion of the trade between seaports in the United States and the Fairbanks and Klondike mining regions, both of which, at times, showed great prosperity. The ultimate intention was to extend the line northeasterly to Circle City, about 130 miles from Fairbanks. Later it was hoped to open extensive coal deposits known to exist on the Matanuska River. The mining districts above referred to are served by two routes, one via the White Pass and Yukon Railroad

A. VIEW SHOWING PORTION OF LINE C. R. & N. W. RY., MILE 65, WHERE WATERS FROM BAIRD GLACIER HAVE A TENDENCY TO WASH OUT THE EMBANKMENTS AND TRESTLE BRIDGES.

B. VIEW SHOWING PORTION OF LINE C. R. & N. W. RY., MILE 65, WHERE WATERS FROM BAIRD GLACIER HAVE A TENDENCY TO WASH OUT THE EMBANKMENTS AND TRESTLE BRIDGES.

from Skagway to Whitehorse, thence down the Yukon River and tributaries, a total distance from Skagway to Fairbanks of 1,110 miles, or from Seattle, approximately, 2,010 miles; the other route being by steamer to St. Michaels, and thence up the Yukon and Tanana Rivers to Fairbanks, a total distance from Seattle to Fairbanks of 3,500 miles. These routes are only available during the summer months, and the rates on both of them were then, and are now, very high. A terminal was selected at Seward, and surveys were begun in 1903. Actual construction began in 1904, and during the summer and fall of that year the line was partially graded and track laid to mile 18, and a wharf built at Seward. The location of the road was extended to mile 33. In December of 1904 the management of the road changed hands and went into the control of A. C. Frost and associates, of Chicago. About the first of April, 1905, construction work was vigorously begun at mile 18 and continued until April 1, 1906, during which period grading was finished to mile 47 and track laid, and certain additional work was done between miles 8 and 18. An office building, costing about $50,000, was built at Seward; some work was done along Turnagain Arm, north of Kern Creek, and through the hills between miles 47 and 66, and several sawmills were erected. Surveys were also continued toward the interior. During the year 1906, the grading was continued with a largely reduced force, and the company's efforts were concentrated on the tunnels and heavy work between miles 49 and 54. In 1909 all construction work was suspended and has never been resumed.

The Alaska Central Railway went into the hands of a receiver about 1908. On August 17, 1909, a decree of foreclosure and sale was entered in the case by the district court for the Territory of Alaska. On October 19, 1909, all the assets of every kind belonging to the old Alaska Central Railway Co. were conveyed by deed of the United States marshal to F. G. Jemmett, trustee. On April 15, 1910, F. G. Jemmett conveyed, by deed, all the said assets to the Alaska Northern Railway Co., with the exception of a small piece of land near the head of Resurrection Bay.

GENERAL REMARKS.

The Alaska Northern Railway, a single track, standard gauge railroad, starts at the town of Seward, on Resurrection Bay, and extends in a northerly direction to Kern Creek, a distance of 70.8 miles. To this latter point rails have been laid and the road has been operated intermittently. For several miles beyond Kern Creek the right of way has been cleared and some grading has been done in disconnected sections. For the past three years, owing to financial troubles and the lack of funds with which to keep the road in repair, the only portion kept open for operation has been from Seward to mile 47. Even this has not been operated during the winter months when the snow is deep enough to seriously interfere. At other times a gasoline car, capable of carrying from 20 to 25 passengers and some light express matter, has been run every few days. To this is sometimes attached a trailer for transporting some heavier freight. A maintenance force, only large enough to keep the road from being absolutely unsafe, is kept at work. As a consequence, the road is in a

very bad physical condition, and expensive repairs would have to be made to make it safe for the operation of equipment of medium weight. Many of the bridges and trestles are in poor condition, some of them being almost entirely washed out. Many slides have occurred, and in several places the roadway has been badly washed. There are many cases along the river bottoms where the embankments, as originally constructed, are too low and should be raised from 1 to 4 feet. The excavations and embankments are, in most instances, too narrow. The tunnels need enlargement in places. Many of the trestles and bridges were not carefully constructed, spikes instead of bolts being used, and the former having shaken out, the trestles are now unsafe. This is particularly true in regard to the high trestles, miles 48 and 50, one of which is near the Bartlett Glacier.

In a number of cases the openings provided for the passage of glacial streams were too low, and the streams, most of them carrying sediment, have entirely filled up the openings. In such cases new openings of greater height will have to be provided. Considerable riprap will have to be placed, especially at the ends of bridges; the drainage ditches will have to be reopened.

About 50 per cent of the ties will have to be renewed, and considerable ballasting should be done. In places heavier rail will have to be substituted for the light rail now in use. Some of this work can be done gradually after the road is put in operation. To put the road in a condition to safely operate light trains from Seward to Kern Creek, it is estimated, would require an immediate expenditure of $500,000 and an ultimate expenditure of nearly a million dollars, which would be extended over a period of years. A detail of this item will be found in Appendix D. Furthermore, it is quite possible that a considerable amount will have to be expended for snowsheds. This can not be determined until an extended study of snow conditions is made.

Some of the present conditions along the line are shown on plates 13 and 14.

DESCRIPTION OF PROPERTY, RIGHT OF WAY, GRADES, AND GENERAL PHYSICAL CHARACTERISTICS.

Starting at the water front, from a wharf extending out to a depth of 45 feet below low water, the line passes along the easterly front of the town of Seward for a distance of three-quarters of a mile. The property owned by the railway company at Seward consists of a narrow strip along the eastern water front with an acreage of about 9 acres. Ownership is claimed to other tracts immediately adjacent to the town, but no title has been obtained thereto. The only improvements on this property are temporary in character, consisting of some structures erected for use as sheds, storehouses, and shops. The railway company also owns a large office building in Seward which is much out of repair.

Leaving Seward, the line follows the shore of the bay in a northerly direction for a short distance, thence across the bottom lands in the Resurrection and Salmon River drainage to mile 6. The grades are very easy and the work light. There are many river channels

ROUND ISLAND CHANNEL BRIDGE, C. R. & N. W. RY., MILE 28.

THE CHUGACH RANGE, C. R. & N. W. RY.

across which are pile trestles. Many of these trestles, with the intervening track, should be raised, as the country is subject to overflow. A little north of mile 6 the line begins to ascend to a summit near mile 12, the elevation of which is 705 feet. There are numerous 10° and 12° curves. The grade, although noted as 2.2 per cent maximum, is in reality about 2.5 per cent maximum, no compensation having been made for curvature. Trestles are numerous, many being on sharp curves. It seems probable that considerable of this excessive curvature could have been avoided by cutting a little heavier in places and reducing the filling—this, without much extra expense. Leaving the summit, the line descends on a maximum grade of about 2.1 per cent (not compensated) to near mile 14½. Trestles on sharp curves are somewhat frequent. Near mile 14, Snow River, a glacial stream, is crossed on a trestle 926 feet long and 30 feet high, part of which is on a 10° curve. Considerable trouble has been experienced at this point, various bents having been taken out by the drift. A steel bridge will probably ultimately be required.

Leaving Snow River, the road descends on easy grades and with light curvature to mile 16.5, where the elevation of 468 is reached. This portion of the line is occasionally flooded and should be raised somewhat. A few short openings are required for flood waters. From mile 16.5 to 17, the grade rises 27 feet, and in the next three-quarters of a mile descends 40 feet. From mile 18 to 23.5 the road follows along the easterly shore of Lake Kenai, with easy, undulating grades but with considerable sharp curvature. Much of this could be eliminated without great expense.

The construction of this portion of the line was fairly heavy, considerable rock being encountered. From mile 23.5 the road, with grade not exceeding 1 per cent and slightly undulating, ascends Trail Creek to Trail Lake at mile 26; thence follows along the west shore of the lake to mile 29.5, where it crosses to the east side and continues to the head of the lake at mile 34. This was accomplished with easy grades and fairly easy curvature and not very heavy work. Several arms of the lake were crossed on trestles several hundred feet in length. Trail Creek is crossed at mile 33. From mile 33 to mile 40 the road follows up Trail Creek, with several crossings of the creek and its tributaries. Quite an amount of low-pile trestle was used, much of which is in poor condition. Most of the road was built on a light fill, much of which is too low and should be raised from 1 to 4 feet, as the country frequently overflows. Near mile 40 there is a wye, and here begins the steep climb to main summit in the Kenai Mountains. This is made on a maximum compensated grade of 2 per cent, with fairly easy alignment. A number of trestles occur, some of which can eventually be filled. Quite heavy rockwork was encountered between miles 43 and 45. Near mile 43 we enter the region where most of the trouble from snow occurs. This, however, is not very formidable, as the snow seldom exceeds 5 to 6 feet on a level. There are snow slides at miles 43.6, 48.2, 49.4, 49.5, 50, 53.2, 53.4, and 70. The summit is reached at mile 45, at an elevation of 1,063 feet. From here the line, following the drainage of the Placer River, descends with a maximum grade of 2.2 per cent and with fairly easy work to mile 47.6. Here begins the heaviest construction on the whole line. For the next 5 miles the location

has been much criticized, but it is not evident that the criticisms are well founded. To have continued down the west wall of the canyon, supporting on the steep transverse slopes, would have given very heavy work and would have introduced great danger from snowslides. A grade rate of 1.5 per cent might have been attained, but no less. The line as constructed enters a tunnel a little north of mile 48, passing through the tunnel a distance of 714 feet, the line turns on a 14° curve to the right, with a total curvature of 235°. Much of this turn is made on a trestle whose maximum height is 106 feet; thence, with 394 feet of reversing tangent, swings sharply to the left with a 14° curve. This alignment could be reduced to 12° curves by boring a new tunnel 1,430 feet in length. This would also allow the trestle to be filled at reasonable cost. Leaving the 14° curve noted above, the line descends on the maximum grade, crossing several high trestles, passing through several tunnels, and cutting various high points to mile 54, where the foot of the heavy grade is reached. In mile 50 and 51 a complete loop is made, the road crossing under itself. At mile 49.2 the road passes in close proximity to the Bartlett Glacier. Should this glacier advance, serious results would ensue, and it would be necessary to change the location of the road in this vicinity. Such trouble is not anticipated. For about a mile, 50.8 to 51.8, the work is a little lighter in character, and here a siding has been placed. Between 51.8 and 53 are six tunnels, aggregating 2,704 feet in length. At mile 53 the Spencer Glacier is passed, but, being across the canyon, no danger is anticipated from it. Near mile 54 the line leaves the side hill, and crossing the Placer River on a high bridge, 1,580 feet in length, reaches the Placer River Valley. For about 3 miles the line crosses a gravel flat, through which pass numerous glacial streams, having the Spencer Glacier as their source. Many short pieces of trestle, aggregating 4,362 feet, with intermediate fills, were constructed in this distance to allow the passage of these streams. The grade of the track not having been made high enough many of the openings have been filled by glacial silt, and the roadbed for nearly 3 miles has been obliterated; 1,820 feet of track is gone completely. (See photographs, pl. 15.)

This will have to be rebuilt by placing most of it on a trestle at a higher elevation. The line follows along the valley bottom of the Placer River to near mile 61 at the head of Turnagain Arm. A number of small glacial streams are crossed on pile trestles. The track is mostly on a low fill and in many places could be raised to advantage. From mile 61 the line skirts the east shore of Turnagain Arm, still on a low fill, to mile 66.3. Several branches of Portage Creek are crossed with trestles from 400 to 700 feet in length. Most of these trestles are in bad condition.

This portion of the road being opposite the pass occupied by the Portage Glacier is subject to very heavy winds at times. Near mile 65 Twentymile River is crossed on a trestle 1,682 feet in length. From mile 66.3 to 67.1 the road cuts through a succession of rock points with intermediate embayments. From 67.1 to 69 the line is mostly on the flat marsh at the head of Turnagain Arm. In order to avoid some bad snowslides the line for over a mile is built on trestles some distance out from the side hill. A series of spur dikes was

MILE 100, C. R. & N. W. RY.

SNOW SLIDE NEAR MILE 53, ALASKA NORTHERN RAILWAY.

erected to protect the trestle from ice and also with the idea that eventually the tidal action would cause a deposit of sand and make a fill. This seems to have worked very successfully, and much deposit has formed at the foot of the trestle. Eventually a fill can take the place of the trestle. From mile 69 to Kern Creek, at 70.8 and the present end of track, the line cuts through a succession of quite heavy rock points, and the work was quite costly. A number of slides have occurred in this section, but none of great magnitude. Some grading has been done beyond Kern Creek in disconnected sections, but no track is laid. From Seward to mile 16½ the track is laid with 56-pound rails; from mile 16½ to end with 65-pound rails.

RIGHT OF WAY.

The act of May 14, 1898, section 47, provides for the grant of a right of way through the lands of the United States in the District of Alaska to any railroad company duly organized under the laws of any State or Territory or by the Congress of the United States which may hereafter file for record with the Secretary of the Interior a copy of its articles of incorporation and due proof of its organization under the same to the extent of 100 feet on each side of the center line of said road.

Pursuant to the act of May 14, 1898, the Alaska Central Railway Co. filed certified copy of its articles of incorporation and proofs of its organization, which were accepted by the Interior Department August 1, 1902. It filed a map showing the preliminary location of the line from a point near Seward northerly to a point on the Tanana River near Atwood, a distance of 402.5 miles. This map was accepted for general information by letters from the Interior Department August 14, 1903.

The Alaska Central Railway Co. filed a map of definite location on the first 20 miles of its road from a point on Resurrection Bay to Lake Kenai. This map received departmental approval June 1, 1905. Subsequently it filed a map of amended definite location of this section of road and proof of construction thereof, which was approved by the department October 31, 1905. A map of definite location showing the second section of 20 miles received departmental approval October 31, 1905. A map of amended definite location of this second section of 20 miles and proof of construction thereof received departmental approval February 25, 1907.

A map showing the preliminary location of the company's line from mile 40.501 to mile 100 on north shore of Turnagain Arm of Cook Inlet was accepted for filing by letter from Interior Department April 23, 1908.

Subsequent to the filing of this map all the property of the Alaska Central Railway Co. was transferred to the Alaska Northern Railway Co. The Alaska Northern Railway Co. filed certified copies of its articles of incorporation and due proofs of its organization, which were accepted by the Interior Department June 3, 1910.

On April 6, 1911, the Alaska Northern Railway Co., as successors to the Alaska Central Railway Co., filed in the district land office at Juneau a map showing the definite location of its line of road from mile 40.501 to mile 70.762 on the north shore of Turnagain Arm and proof of construction of said section of road. This company also

filed applications for station grounds; also an application for right of way for the definite location of its line of road from mile 70.762 to mile 100. These applications all affected lands within the Chugach National Forest, and were thereafter referred to the Forester, Department of Agriculture.

The Secretary of Agriculture reported that the railway company had been called upon for stipulations required by the Department of Agriculture for the protection of national-forest interests, and that it had failed to execute them or give any satisfactory reason for its failure to do so. The company was cited to show cause why its application should not be rejected on account of its failure to comply with the requirements of the Department of Agriculture. Several extensions of time were granted the company within which to answer, but no reply was received within the time allowed.

On June 30, 1906, Congress passed the following act for the benefit of the Alaska Central Railway:

> Said company shall have three years from the passage of this act within which to file a map of definite location, until which time all their rights originally secured by the filing of their plats of preliminary location shall continue, and six years from the date of filing such maps of definite location within which to complete said railroad to the Tanana River.

This allows the railway company a possible nine years from June 30, 1906, to complete their road to the Tanana River.

LINE FROM TRAIL CREEK SUMMIT ON THE ALASKA NORTHERN RAILWAY, DESCENDING TOWARD TURNAGAIN ARM ON MAXIMUM OF 1.5 PER CENT COMPENSATED GRADE.

As mentioned elsewhere, the statement has frequently been made that a grave mistake was made in locating the Alaska Northern Railway and that, leaving Trail Creek summit, the line should have followed down the west wall of the canyon and rejoined the present line near mile 58 instead of putting in the forced developments by means of the loop near mile 50. It has been stated that this would probably have resulted in getting a line without excessive curvature, with a grade possibly as low as 1.1 or 1.2 per cent, and that the cost would probably have been as little as that of the present line.

It is evident from inspection that a grade as low as 1.2 can not be obtained, so a line was located on a 1.5 maximum grade, resulting as follows: Leaving Trail Creek summit, near mile 45, at an elevation of 1,064 above sea level, the line for about 2½ miles follows along easy slopes and with fairly easy work. The material is shale and slate, with a covering of 1 to 5 feet of earth, in which grows dense thickets of alder brush. In the next half mile there are two tunnels, with an aggregate length of 850 feet, separated by a chasm 130 feet deep, and requiring a viaduct 650 feet in length. From mile 48 to mile 59, where the line reaches the Placer River flat, the work is exceedingly expensive. The line is supported on heavy transverse slopes and consequently has to be benched heavily.

Two tunnels will be necessary of an aggregate length of 770 feet. Two viaducts, each over 125 feet in height, will be required and much very expensive excavation. The material is mostly a medium hard shale with a light covering of earth, on which there is a dense growth

A. SLIDES ON ALASKA NORTHERN RAILWAY NEAR KERN CREEK.

B. LOWER END OF BIG TRESTLE, SPENCER GLACIER FLATS.

A. LOOKING ACROSS SPENCER GLACIER FLATS.

B. TRESTLE AT MILE 63, ALASKA NORTHERN RAILWAY.

of alder brush in many places. Occasionally, for short distances, the transverse slope lightens a little and the work is easier, but these instances are rare.

At mile 59 the line reaches the Placer River flats and crosses on a light fill, a distance of about 4 miles, reaching the constructed line of the Alaska Northern at about 64.56 miles from Seward and the surveyed line from Passage Canal at mile 12.5 from that point. By this line the distance from Trail Creek summit to the intersection with the Alaska Northern is 17.6 miles, as against 18.9 by the latter line. Along the steep side hills a number of snowslides are apparent and probably long distances of snowsheds will be required. The estimate for the construction of the 18.29 miles of line is $2,574,500, including tracks and buildings but not including snowsheds, for which a large amount would probably have to be expended. It is possible that a line starting from Trail Creek summit and following along the west wall of the canyon with a 2.2 per cent maximum grade might give better results than the Alaska Northern, but it is doubtful because of the menace of the snowslides.

(C) THE TANANA VALLEY RAILROAD.

The Tanana Valley Railroad is a narrow-gauge (3 feet) single-track steam railroad, 44.7 miles in length. It has a terminus at Chena, at the head of navigation on the Tanana River, and one section of the line, 9 miles in length, extends to Fairbanks, which may be called the main terminal. A line 35 miles in length extends to Chatanika, in the mining district, from a junction point 5 miles from Chena and 4.7 miles from Fairbanks.

Fairbanks, while sometimes referred to as the head of navigation for river steamers, is often cut off from river service on account of low water, and the Tanana Valley Railroad was built to handle the freight and passengers from Chena to Fairbanks and to serve the mining district in the vicinity of Gilmore and Chatanika.

The railroad company has four recorded terminal grounds, as follows: Chena, 18.15 acres; Fairbanks Junction, 40 acres; Fairbanks, 19.802 acres; and Gilmore, 40 acres.

At Chena the terminal is above the town on the north bank of Chena Slough near its confluence with the Tanana River, but the road runs west from this point for 0.67 mile through the main street of the town to the docks along the river front.

Starting at Chena Dock, the road runs northwest for 5 miles up the Tanana Valley to Fairbanks Junction over some low, swampy ground which is subject at times to overflow. The alignment is good, but the track is carried on low embankment without ballast. From the junction to Fairbanks, 4.7 miles, the railroad continues up the valley and crosses Noyes Slough, about 2 miles from the junction, on a pile trestle bridge. The bridge is occasionally carried away by high water and accumulated driftwood. Garden Island Slough is crossed just before reaching Fairbanks. The railroad company has a combined station and office building at their Fairbanks terminal, also a good warehouse and engine house.

The railroad to Chatanika runs about due north from Fairbanks Junction up St. Patrick Creek from elevation 526 at mile 5 from

Chena to elevation 672 at mile 7.4. Several short pile bridges are crossed. Some of the best farm lands in the Fairbanks district are to be found in this section.

At mile 7.4 the line curves to the east and follows the south side of Goldstream Creek to mile 12.5, where it crosses Goldstream and keeps up the north bank to near Gilmore. At Fox, about mile 18, it crosses Fox Creek near where Fox and Pedro Creeks join to form Goldstream Creek and follows up Pedro Creek for a little over 2 miles, where the line makes a double crossing of the creek on high trestles and swings over to the slope of the northern side hill, which is followed back into Fox Creek to gain elevation. Near mile 27 Fox Creek is finally crossed and the summit is gained near mile 28 at an elevation of 1,496 feet. The railroad follows down the east side of Vault Creek on a descending grade to Chatanika River Valley at mile 35. Between miles 17 and 35 the roadbed is in bad condition, and there are a large number of trestles on sharp curves which will soon have to be renewed. From mile 35 to Chatanika, mile 40, the alignment is good and the roadbed is in fair condition.

No heavy grading work was undertaken in the construction of this railroad. The grade line was laid close to the ground, and heavy grades were used to pass over the ridges. The valleys were crossed on wooden trestles.

The equipment of the railroad, including locomotives, cars, etc., is in poor condition.

The cost of the Tanana Valley Railroad to date is $867,000, with a present bonded indebtedness of $666,000. The following table gives a condensed statement of earnings, expenses, and traffic during the past six years:

Year.	Gross earnings.	Expenses.	Net earnings.	Number of passengers carried.	Number of tons of freight carried.
1909	$298,250.54	$182,347.77	$115,902.77	49,205	15,809
1910	250,537.30	167,440.79	83,096.51	53,248	15,535
1911	160,659.98	116,615.32	44,044.66	34,629	11,867
1912	186,868.00	100,702.01	86,165.99	38,915	16,842
1913	167,758.67	110,608.50	57,150.17	41,682	13,210
1914	116,579.50	94,259.81	22,319.69	27,832	10,231

The Tanana Valley Railroad has been a great boon to the mining industry of the Fairbanks district and in the past has paid good interest on the investment. The earnings of the railroad have lessened, gradually, as the mining industry has decreased, although the railroad still pays more than $22,000 annually over and above the cost of maintenance and operation.

If coal from the Nenana fields could be delivered to this railroad at either Chena or Fairbanks, an increased traffic would undoubtedly result, as the new fuel would be used by the miners throughout the placer district in preference to the wood which is now being consumed. It is also reasonable to assume that quartz mining would become active if coal were furnished to the mines in this district at a reasonable figure.

PLATE 16.

TRESTLE AT MILE 63½, PORTAGE CREEK, ALASKA NORTHERN RAILWAY.

DOUBLE LOOP, ALASKA NORTHERN RAILWAY, MILES 47 TO 51, BARTLETT GLACIER VALLEY.

GENERAL RAILROAD SYSTEMS.

Reference has been made in another part of this report to the two general routes or railroad systems which present themselves for the consideration of this commission. A detailed description of each route appears on the following pages.

Comparative table of distances.

	Miles.
Western route:	
Seward to first navigable waters of the interior	414.7
Passage Canal to first navigable waters of the interior	362.1
Ship Creek to first navigable waters of the interior	304.1
Seward to Fairbanks	471.0
Passage Canal to Fairbanks	418.4
Ship Creek to Fairbanks	360.3
Seward to Chickaloon (Matanuska coal fields)	185.5
Passage Canal to Chickaloon (Matanuska coal fields)	132.9
Ship Creek to Chickaloon (Matanuska coal fields)	74.9
Eastern route:[1]	
Cordova to Fairbanks	444.0
Valdez (Thompson Pass) to Fairbanks	380.0
Valdez (Marshall Pass) to Fairbanks	411.0
Cordova to Bering River coal fields	79.0
Controller Bay to Bering River coal fields	25.0
Cordova to Chickaloon	294.0
Valdez (Thompson Pass) to Chickaloon	209.0
Valdez (Marshall Pass) to Chickaloon	261.0

EASTERN SYSTEM.

PHYSICAL DESCRIPTION.

Prince William Sound, a large bay indenting the south coast of Alaska, lies between 60° and 61° north latitude and 146° and 149° west longitude. It is surrounded on the north and east by the mountains of the Coast Range and on the west by the Kenai Peninsula. There are numerous islands along the southern limits of the sound, separating it from the waters of the Gulf of Alaska. The many indentations of the coast line on the north, east, and west, protected by the outlying islands on the south, form natural harbors for the largest ocean-going vessels. These harbors are ice free throughout the year.

The Coastal Range forms a broad barrier between Prince William Sound and the wide Delta of the Copper River which debouches into the Gulf of Alaska through many mouths. The Chugach Mountains, encircling this district on the north, forms the southern limits of a narrow inland plateau, extending northward for 75 miles to the base of the Alaska Range.

The Copper River rises on the northern slopes of the Wrangell Mountains, 150 to 200 miles from the south coast, near the source of the Nebesna and Tanana Rivers. It flows around the north and west base of this group and turns south to break through the Chugach Range 100 miles from the coast. For the greater part of its distance it is inclosed in walls of steep mountain sides, the exception being near the points of confluence with the Tazlina and Gulkana Rivers, where the inlands flats above referred to are located.

[1] On the eastern route the first navigable waters of the interior are reached at Fairbanks.

The Alaska Range separates the interior plateau from the Fairbanks quadrangle on the north. The lowest passes over this wide range are at an elevation of 3,500 feet above mean sea level. The water from the Tangle Lakes, at the summit of the range, finds an outlet in either direction, to the south through the Gulkana River and Copper River to tidewater, and to the north through the Delta and Tanana Rivers to the Yukon.

The Delta River, rising at the summit of the Alaska Range, flows due north for 80 or 90 miles and joins with the Tanana River at a point 90 miles above Fairbanks. Its course for half its length is in the mountains on the northern slope of the Alaska Range; its lower portion lies in the Tanana lowlands in a wide, shallow bed with many channels.

THREE POSSIBLE ROUTES.

There are three possible routes into the interior of Alaska from the Prince William Sound district, as follows:

(*a*) From Cordova, on Orca Inlet (or Katalla or Controller Bay), to the summit of the Alaska Range via Copper River Valley, thence northward down the valley of the Delta River to the Tanana lowlands and Fairbanks.

(*b*) From Valdez (or Port Valdez), at the extreme northeast corner of Prince William Sound, to Marshall Pass, in the Chugach Range, via the Keystone Canyon of the Lowe River, thence down the northern slope of the Taznuna River Valley to join with the Copper River route at a point 87 miles from Cordova.

(*c*) From Valdez (or Port Valdez) up the valley of the Lowe River, through Keystone Canyon to the summit of the Chugach Range, thence northward over Thompson and Earnestine Passes, and down the Tonsina River to a point near Copper Center, there joining with the route Cordova to Fairbanks.

(*a*) CORDOVA-CHITINA TO FAIRBANKS.

The route from Cordova follows up the Copper River and Gulkana River to the southern slopes of the Alaska Range, which it crosses at an elevation of 3,500 feet, thence follows the water grade of the Delta River to the Tanana lowlands and Fairbanks.

The present Copper River & Northwestern Railroad forms the southern end of the eastern system. It has been previously described on page 19 of this report. The section Cordova to Chitina, 131 miles, would form part of the trunk line; the section Chitina to Kennecott, 64 miles, would extend as a spur in an easterly direction to the Bonanza mine.

A locating party organized in Alaska was put into the field on June 1 to survey the line from Chitina northward toward Copper Center up the valley of the Copper River.

From mile 1 to 13, inclusive, the line held the west bank of the river; the work is very heavy, due to the steep slopes and cliffs. In this section it was necessary to take three tunnels, with a total length of 1,150 feet; the formation is a good slate, which will not require lining. All of the solid rock encountered on the first hundred miles occurs in this section. It is a good, blocky slate that should not cost more than $1.50 per cubic yard to move.

COPPER CENTER, ALASKA. LOOKING ACROSS KLUTINA FROM EDGE OF THE MIDDLE FLAT, NEAR VALDEZ-FAIRBANKS WAGON ROAD, COPPER RIVER IN DISTANCE.

UPPER VALLEY OF DELTA RIVER; RAILWAY ROUTE COPPER CENTER TO FAIRBANKS.

From mile 13 to mile 23, the line follows the west bank of the Tonsina River. In this section a few frozen cuts are encountered, the material being gravel. There is a heavy cut on mile 18 that should be opened by steam shovel and the material used to build, by train haul, portions of this section of the line from mile 13 to mile 23.

The line crosses the Tonsina River in mile 23 on one 200-foot and one 100-foot through wooden Howe truss spans supported on reinforced concrete piers and abutments with pile foundations. The river at the crossing is confined in one channel between high banks with no chance for its cutting out new channels.

From mile 23 to 24 the line crosses to the east bank of the Tonsina River and at mile 25 leaves the river and follows up Willow Creek, using 2 per cent grades. The estimated cost of construction for the first 25-mile section averages $57,000 per mile, including bridge, completed tracks, telegraph line, etc.

From mile 26 to mile 28 the line follows up Willow Creek. Some heavy work is required in mile 26 in order to avoid bad alignment. At mile 28 the line reaches the top of the high banks which lie west of the Copper River.

From mile 28 to 44 the line lies 3 miles west of the Copper River and parallel to it. This section of the line shows very light work and the roadbed should be built by train haul. There are numerous small lakes and ponds in this district; the timber is very sparse, mostly scrub spruce. There are one or two very prosperous homesteads along the Government wagon road.

From mile 44 to 47 the line drops down to the Klutina River on a 2 per cent grade. The crossing of the river is effected at a point *about* 1½ miles west of Copper Center, at an elevation of 55 feet above high water. The estimate for the bridge calls for one 200-foot deck truss carried on reinforced concrete abutments, set on pile foundations. The crossing is reported to be absolutely safe, with no chance of the river changing its channel.

From mile 47 to mile 50 the climb is made from the bridge to the bench which lies between the Klutina and Tazlina Rivers, using a 2 per cent grade. The cost of construction for the section, mile 26 to mile 50, inclusive, averages about $37,000 per mile.

From a point near Copper Center the locating party branched off from the trunk line and surveyed the spur line to the Matanuska coal fields, 113 miles west of Copper Center. This program was followed because the commission was without any information in regard to the line, grades, country passed through, etc., Copper Center to Chickaloon. There had been no previous survey over that route. The commission did have at hand, however, through the courtesy of the management of the Copper River & Northwestern Railroad, the complete report of the engineer who had made a careful reconnoissance survey of the route Copper Center to Fairbanks in 1910, together with estimates of cost. The commission believes it would be desirable to insert this report and estimate in its entirety rather than to attempt to describe the line from the hasty reconnoissance made over the wagon road. (See Appendix E.) In studying this report it would seem that if any error exists it would be on the side of too little cost. In several sections of the line the quantities indicated average only 7,000 cubic yards to the mile, which seems low, not-

withstanding the fact that the country passed through is very regular. The report in question was made by Mr. Henry Deyo, a thoroughly competent civil engineer and the same man secured by the commission to locate the line Chitina to Chickaloon. A member of the commission went over the notes and estimates with Mr. Deyo, and in this conference certain changes were suggested. The estimate appearing in Appendix E takes into consideration these changes.

The following is a transcript from Mr. Deyo's 1910 report, Copper Center to Fairbanks. The full report will be found in Appendix E.

* * * From the crossing of the Klutina River to the Tazlina the line is along a high bench that lies west of the Copper River. Very favorable conditions prevail. The work is light and the material is fairly good.

At mile 59 it will be necessary to change the channel of the Tazlina River. The material through which the cutting for the new channel will be made is very light gravel and clay. After cutting a channel 100 feet wide the action of the water will sluice out channel to sufficient width.

The Tazlina is crossed at mile 61, about 200 feet east of the mouth of Moose Creek. This is a good crossing and the best that is to be had on the river. At this point the river is confined in one channel about 350 feet wide, and the banks on both sides show no evidence of cutting. From the Tazlina River the line will follow up Moose Creek for about 4 miles. It will be necessary to cross the creek a number of times. It is a small stream and 60-foot pile trestles will answer every purpose.

At mile 65 we are on the top of a bench, and from there to mile 106 the work of grading will be extremely light. On this bench country there are numerous small lakes and a number of grassy sloughs, but they are not swampy. There was no difficulty in getting the horses through this country, although we had been advised that it would be impossible to get stock through on account of the numerous floating swamps that would be encountered. This extensive bench country is covered with a growth of scrub spruce and willows.

The line crosses the west fork of the Gulkana at mile 107. This crossing will require one 150-foot through span. From the crossing of the west fork to the summit on mile 125 the work is very light, with practically no bridging. Fourth of July summit at mile 125 is a very broad pass, with an elevation of about 3,500.

From mile 125 to 135 the country is cut up into small pockets and hills. The material is a very fine gravel, with very few bowlders or gravel larger than 6 inches in diameter.

The line from mile 135 to 153 crosses numerous tributaries of the Delta River, but they are all small, clear-water streams. At mile 153 the Delta forms a box canyon, and at this point it will be necessary to take a 700-foot tunnel. In this canyon there is a fall of the river of about 95 feet. Mile 153 and 154 will show heavy work owing to the fact that there is no support on the side of the canyon for about 2½ miles, until the bottom land is reached again. The excavation encountered will be in solid rock. It is the first since leaving the Tonsina River.

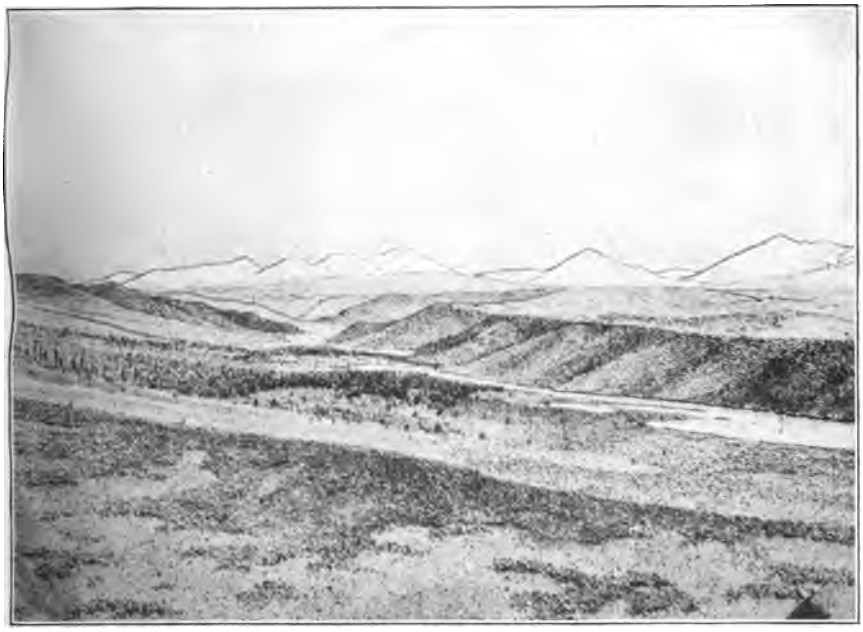
From mile 155 to 163 the line follows along the west side of the Delta River. There is a valley most of the distance, and where there is not the line will follow the smooth slope that will not exceed 10 per cent.

At mile 163 the line crosses the mouth of Canyon Creek. This is a glacial stream and carries considerable more water than does the Delta at this point. Canyon Creek at the mouth is confined to one channel about 100 feet in width. It is 3 feet deep and flows at a velocity of 8 miles per hour. It carries no drift and a pile trestle could be maintained.

From mile 164 to 166 there is considerable rock work, mostly along the cliff side.

From mile 166 to mile 185 the valley extends about halfway. For the remainder of the distance the line will follow smooth slope of abut 10°. At mile 185 the line crosses the stream that drains the Rapids Glacier. This stream is 150 feet wide and very swift. It is a typical glacial stream, but has evidently been confined in the same channel for a number of years.

From mile 185 to 190 the line is in a broad valley. At this last point we leave the mountains and reach the broad level valley on the west side of the Delta. This extends northerly as far as the eye can discern. The line would follow the west side of the Delta to its mouth, then down the south side of the Tanana to the mouth of the Little Delta on mile 255. From this point to



DIVIDE BETWEEN DELTA AND COPPER RIVERS; RAILWAY ROUTE COPPER CENTER TO FAIRBANKS.

the terminus of the survey at mile 310 on the south bank of the Tanana River opposite Chena, the line would be across the valley of the Tanana River in a country that would require very little curvature. The line from 190 to 310 will average about 14,000 cubic yards of earth to the mile, 50 per cent of which is probably frozen and 50 per cent probably thawed. Bridges will average about 300 feet in length of pile trestle per mile * * *.

From the above it will be noted that Mr. Deyo made his survey along the south bank of the Tanana River to a point opposite Chena. In order to obtain a suitable crossing of the Tanana River it will probably be necessary to cross the river to the north bank at a point near the mouth of the Little Delta River. This is one of the few places in this section where the Tanana River is confined in a single channel. At points below the Little Delta River, the Tanana River broadens out into numerous channels and it would require a very long and expensive bridge to cross the river.

Plate 20 shows a view of the Tanana River near its confluence with the Little Delta.

(*b*) VALDEZ-MARSHALL PASS ROUTE.

The harbor of Valdez was selected by the pioneers of the Copper River & Northwestern Railroad project for the tidewater terminal of a raliroad to the Kennecott mines, over the Marshall Pass route. Surveys were made and considerable grading work was accomplished when certain elements caused a change of plans.

The existence of coal suitable for coking purposes in the Bering River field was the prime factor which caused the management, interested in both the mining and the railroad projects, to abandon the plans for a terminal at Valdez and select the terminal at Katalla.

The terminal was again shifted to Cordova upon the failure of certain harbor improvements undertaken at Katalla.

The high coastal range approaches so close to the shores of Valdez Bay that it requires the use of very steep gradients to overcome the difference in elevation between the mountain passes and sea level.

The snowfall in this locality is extremely heavy.

A reconnaissance was made over the Valdez-Marshall Pass route by a member of the commission in the month of November. The old location started at Port Valdez and followed along the north shore of Valdez Bay to the town of Valdez at mile 6. Valdez is built upon an extensive gravel deposit washed down from the Valdez Glacier, and the railroad line crossed these flats and Robe River and extended up the northern side of the Lowe River Valley on very easy grades to the Keystone Canyon, a narrow, rocky gorge, 5 miles in length, having precipitous sides. Considerable construction work had been accomplished in the Keystone Canyon, part of which is made use of by the Government wagon road leading through to the interior. At mile 21, at the head of the canyon, the heavy climb begins to reach the summit of Marshall Pass. The elevation of the grade at the head of the canyon is 350 feet above mean sea level, and it is necessary to rise to elevation 1750 in 14 miles on maximum 3 per cent compensated grades to get over the divide to the head of the Tasnuna Valley. The line from Valdez to Marshall Pass has been definitely located on the ground, curves run in, profile made, and excavation, embankment, and bridging quantities figured.

From Marshall Pass to the Copper River & Northwestern Railroad there had been no definite location made, but a preliminary line, 23 miles in length, had been run over the entire distance. The line was laid along the slopes of the mountains forming the north wall of the Tasnuna Valley, descending on a 2½ per cent grade, eastbound. The survey cutting, while several years old, was still very plainly marked and could be followed without difficulty. The line connected with the Copper River & Northwestern Railroad at mile 87.

It is possible that the grade approaching Marshall Pass from Keystone Canyon might be reduced to 2.5 per cent by keeping the line on the south side of the Lowe River Valley and introducing some curvature and distances. This could only be determined by a field survey.

(*c*) THOMPSON PASS ROUTE.

The route to the interior via the Thompson Pass and the Tonsina River would be identical with the Marshall Pass Route up the Lowe River Valley and through the Keystone Canyon for a distance of 32 miles. About 3 miles before reaching Marshall Pass the line makes a 6-mile loop to the west on a 3 per cent maximum grade to develop enough distance and elevation to cross the pass at 2,750 feet above sea level.

Two tunnel projects have been considered to reduce the grade and distance over the pass and to overcome the heavy snow conditions. One tunnel was projected 980 feet long, saving 150 feet in elevation, and another 4,000 feet long, saving 350 feet elevation.

The country from Thompson Pass to Beaver Dam is rugged in character. The line is benched in on the side hills on the east side of the Tonsina River until the canyon is reached, when it crosses and continues down the west side, using 3 per cent grades. About 5 miles beyond Beaver Dam the location crosses Stewart Creek, requiring heavy work in the canyon, and from this point (elevation 1,100) starts a rising grade, plus 1.6 per cent, to a low pass at Earnestine (elevation 1,830). From Earnestine Pass the line follows Mosquito Creek on minus 1 per cent grades to its confluence with the Tonsina, thence down the west bank of the Tonsina to the mouth of Trout Creek. From Trout Creek to the Copper River the line follows in general the location of the Government wagon road. From Copper Center the route to Fairbanks is identical with that from Chitina.

The commission believes that little serious consideration can be given to the Thompson Pass route to the interior, as the grades and snow conditions are hot favorable. It is necessary to overcome 2,750 feet elevation in the first 35 miles, requiring 3 per cent grades.

It would be preferable for a line from Valdez to the interior to follow the Marshall Pass-Tasnuna-Copper River route.

SPURS TO MINING CAMPS.

Among the possible extensions from the trunk line of the eastern system, in seeking new tonnage and mining development, the following spur lines may be mentioned. With the exception of the first named, these lines have not been investigated and the commission is

ABANDONED RAILROAD GRADE NEAR VALDEZ.

TASNUNA RIVER VALLEY, VALDEZ TO MILE 87, C. R. & N. W. RY., BY WAY OF MARSHALL PASS.

without authentic information as to their probable cost or true merit.

(*a*) The spur line to Bering River coal fields from mile 39, via Lake Charlotte.

(*b*) The Kotsina spur, mile 139, Copper River & Northwestern Railroad.

(*c*) The Strelna spur, mile 146, Copper River & Northwestern Railroad.

(*d*) The McCarthy Creek spur, mile 191, Copper River & Northwestern Railroad.

(*e*) The McCarthy-Nizina River spur, mile 191, Copper River & Northwestern Railroad.

(*f*) The spur from Copper Center to Chickaloon in the Matanuska coal fields.

(*g*) The spur from mile 260 to reach the coal fields at Dry Creek.

(*a*) *Bering River branch.*

One of the most important coal branches to be considered with the eastern route is the line from the Bering River coal fields to the Copper River & Northwestern Railroad at mile 39. This line would probably follow what is known as the Lake Charlotte route. Leaving mile 39, the line crosses several sloughs and streams of the Copper River and enters Martin River Valley. For 8 miles the line lies in the lowlands of the valley of the Martin and Tokun Rivers; the ground is swampy but underlain with glacial gravel. There are patches of spruce timber and thickets of alder and willow brush alternating with open swampy areas. Innumerable small streams are crossed originating in the northern mountains and glaciers.

At mile 8 a connection is made with the old Whorley survey, which was started from mile 49, Copper River & Northwestern Railroad. The juncture of the old and new lines forms the terminus of the new survey work, but the old line was cut out and rechained for several miles and a new profile obtained. From mile 8 to 15, the crossing of Martin River, the line lies on the lower slopes of the high hills. Martin River is a typical glacial stream spreading out over a wide flat into many channels; at mile 20 the line lies against the northern slopes of a spur of ragged mountains. The line skirts the south shore of Deadwood Lake and crosses a low summit in mile 23 to the shore of Lake Charlotte. On the hills west of Lake Charlotte are the nearest coal occurrences. The country in the neighborhood is heavily timbered with an excellent quality of spruce, all lying within the limit of the Chugach forest reserve. Trees 4 and 5 feet in diameter were noted by members of the commission near Lake Charlotte and down Shepherd Creek. From the foot of Lake Charlotte the line lies in the valley of Shepherd Creek on the east side of the creek against the Kustaka Ridge. Several swift streams must be crossed before the toe of the ridge is reached and the line curves sharply to the west and follows the south and east shore of Kustaka Lake, near Cunningham Ridge, at about mile 40. That part of the route lying in Shepherd Creek was personally noted by members of the commission and no difficulties of construction were apparent.

An estimate of the cost of constructing the first 25 miles of this line will be found in Appendix Z.

(*b*) *The Kotsina spur, mile 137, Copper River & Northwestern Railroad.*

At Kotsina, mile 137, there could be built a spur, 27 miles in length, up the Kotsina River to work certain mining properties.

(*c*) *The Strelna spur, mile 146, Copper River & Northwestern Railroad.*

At Strelna, mile 146, a spur 20 miles long could be built up the Kuskulana River to reach mining properties. It is reported that this line would be easy to construct.

(*d*) *The McCarthy Creek spur, mile 191.*

A very short spur could be extended from McCarthy, up McCarthy Creek for a distance of 14 miles, to reach the copper district south and east of the Kennecott mines. The most important property in this district at present is the "Mother Lode."

(*e*) *The McCarthy-Nizina River spur, mile 191, Copper River & Northwestern Railroad.*

A similar spur line, 17 miles in length, could be extended from McCarthy up the Nizina River to Dan Creek to reach a certain gold placer district.

(*f*) *The spur from Copper Center to Chickaloon in the Matanuska coal fields.*

A spur line could be extended from Copper Center to Chickaloon, in the Matanuska coal fields, along the north shore of Tazlina Lake. Such a line was surveyed by party No. 10. The following is the description.

Distances given are from Chitina.

Leaving the main-line route from Chitina to Fairbanks, near Copper Center, mile 51, and turning westward, the line with ascending grade follows the high bench south of the Tazlina River to mile 72. The maximum grade used is 2 per cent. The work is very easy, being largely light filling, with occasional short openings. The ground being mostly frozen it will probably be inadvisable to open any borrow pits on the side, but instead haul in material by train. Near mile 71 a summit is reached at an elevation of 2,175. From this summit the line descends with a 1 per cent maximum grade toward the crossing of the Tazlina River. From the summit to the end of mile 74 the same light character of work continues. From mile 51 to mile 74, inclusive, the estimated cost, including track buildings, etc., is $20,000 per mile. From mile 74 the country becomes somewhat more rolling, but the work is still light in character. The Tazlina River is reached near mile 79, the crossing of which will require 1,330 feet of trestle, averaging about 30 feet in height. This crossing is at the outlet of Tazlina Lake. The line now follows the north shore of the lake to mile 84. The work is easy, being mostly in

KEYSTONE CANYON AND WAGON ROAD FROM OLD TRAIL.

light filling. From mile 84 to mile 89 the line climbs up on the high bench that lies east of the Nelchina River. The maximum grade used is 2 per cent. The country is more rolling, and several summits are passed over. Some few ridges are cut through and a few small streams crossed. The line, with the exception of about 5 miles along Tazlina Lake, passes over frozen ground, and the fills had best be made by train haul. Estimated average cost per mile 76 to 100, inclusive, $23,400 per mile. At mile 100 an elevation of 2,353 is reached. From here on drops down with 2 per cent maximum grade to the Little Nelchina River at mile 102. This stream will be crossed at an elevation of 2,286, about 40 feet above high water. One 200-foot deck span with about 800 feet of approach trestle will be required. After crossing this stream we climb up to the high bench lying north of Eureka Creek. The maximum grade of 2 per cent is used quite freely to mile 110. Eureka Creek is a tributary of the Big Nelchina River and heads in Tahneta Pass, which is the separating point between the Nelchina and Matanuska River drainages. From mile 110 the line climbs with easy grades to the pass which is reached at mile 118.2, at an elevation of 2,970. Several small creeks are crossed, and the line passes in the vicinity of a number of small lakes. After going through Tahneta Pass it is necessary to hold the grade line up to avoid the mud banks and large gulches that empty into the Matanuska. At mile 123 we reach the grade summit at an elevation of 3,007. From mile 121 to 125 we are following the high bench north of the Matanuska River. Estimated cost per mile 101 to 125, inclusive, is $28,800. From mile 124 the line descends on a 2 per cent maximum grade, following the Matanuska River. The work is easy until mile 128 is reached, when the country begins to get much rougher. At mile 128.8 Feather Creek is crossed with framed trestle, about 75 feet high and 252 feet long. In mile 128 much solid rock appears in the formation. At mile 129.8 Jackass Creek is crossed on a 250-foot deck truss about 170 feet above the creek. From mile 130 to 134 we support down the south side of Sheep Mountain, using the maximum grade. At mile 133 Caribou Creek is crossed at an elevation of 395 feet above the water. It is planned to use three spans of 130 feet, 500 feet, and 280 feet, respectively. This crossing can not be avoided. It is not practicable to support down the Matanuska River, owing to the sliding mud banks and deep gulches, and it is necessary to hold the grade line up to avoid the part of Mataluska Glacier that lies below the mouth of Caribou Creek. From this crossing we make a slight ascent and then descend again to the maximum grade. The work becomes somewhat lighter, and no rock appears in the formation.

From mile 135 to 139 the line supports down the mountain side. At mile 139.2 we pass through the divide between the Matanuska River and Pinochle Creek. This is done with a very heavy cut in frozen earth. From this divide down it is necessary to develop considerable distance. To avoid this development it would be necessary to follow along the shale bluffs of the Matanuska River on ground that it would be impracticable to build through. From mile 139 to 144 the line follows down Pinochle Creek to its mouth near 143.5. At mile 144.2 we are forced to cross the Matanuska River to avoid

the heavy slate bluffs lying on the north side. This crossing requires one 300-foot through span about 30 feet above the stream and 500 feet approach trestle. For about a mile west of the crossing the work is heavy, there being several good sized rock cuts. From mile 145 to mile 150, the line follows the south side of the Matanuska River mostly in light filling. The estimated cost per mile from mile 126 to 150, inclusive, is $77,000. From mile 151 to mile 154 the line follows the valley lying south of the Matanuska River. The work is very light and the material good. Near mile 154 we strike several rock points requiring considerable excavation. Near mile 155 the line makes a short ascent to reach a bench about 70 feet above the river. It is not feasible to support around the foot of this bench as the material is light and easily washed away. At mile 155.7 we begin to drop down from this bench, reaching the bottom near mile 157. After leaving the rock points near mile 154 the work is easy, the material being earth. Near mile 157 a rock point is encountered probably requiring a tunnel about 250 in length. The line continues on the south side of the Matanuska River to mile 161.7. With the exception of a few shale rock points near mile 159 the work is light and the line easy to maintain. For about half a mile in this vicinity we pass along a soft shale bluff which stands at a slope of 40°. This bluff is apparently frozen and shows a good many faults. It will be advisable to throw the line well out toward the river at this point, and then by driving piles and filling in behind them endeavor to hold the river. Near mile 162 the line crosses the Matanuska River to the north side. The crossing is made with two 150-foot through spans. The river is confined in a small channel and the bed rock crops out on both sides. About 600 feet ahead, the Chickaloon River is crossed with a through truss 100 feet long. At mile 162.08 the line joins the line from Chickaloon to Matanuska Junction. The estimated cost from 151 to 162, inclusive, is $41,000 per mile. The total cost for this branch from mile 50 to 162 plus is $4,520,061, including track, buildings, etc.

(*g*) *The spur from mile 260, to reach the coal fields at Dry Creek.*

A spur line about 35 miles in length could be constructed from mile 260, a point near the confluence of the Little Delta and Tanana Rivers, in a southwesterly direction to reach the known coal beds of Dry Creek. The map shows that the line would follow across the flat Tanana lowland for about 20 miles and then extend up Dry Creek for 15 miles to the coal beds.

WESTERN SYSTEM.

PHYSICAL DESCRIPTION.

Kenai Peninsula is connected with the mainland by an isthmus about 12 miles wide, separating the waters of Portage Bay from those of Turnagain Arm. A railroad from Prince William Sound to the interior over the Western Route would have its terminus on Portage Bay, and a railroad from the Kenai Peninsula would have its terminus at Seward at the head of Resurrection Bay. Both of

these harbors are described in the following pages. From the head of Turnagain Arm the lines from either terminal would follow a common route along the north shore of Turnagain Arm and around the head of Cook Inlet toward the Susitna Valley, passing the mouth of the Matanuska Valley, which contains the known coal fields 40 miles distant from Knik Arm.

Cook Inlet is an indentation of the North Pacific Ocean lying west of the Kenai Peninsula which separates it from Prince William Sound. It is about 200 miles from the entrance at Cape Elizabeth to the head of Knik Arm. Several large streams, the Matanuska, the Knik, and the Eklutna Rivers, carrying great quantities of gravel and sediment, enter the head of Knik Arm, transferring it into a series of deltas and mud flats unfavorable for the navigation of any but small-draft vessels. The tides in this section are very high and swift tidal currents which are a menace to navigation result.

The Coast and Geodetic Survey, Department of Commerce, made a complete hydrographic survey of Knik Arm during the summer season of 1914, and a copy of the preliminary report of the officer in charge will be found in Appendix J.

The Susitna River, rising far in the interior between the mountains of the St. Elias and the Alaska Ranges, flows in a general westerly direction to the head of the valley which bears its name, then due south to Cook Inlet for a distance of 130 miles. It receives numerous tributaries rising in the Alaskan and Talkeetna Mountains, the more important of which are the Chulitna, the source of which is in the mountains of the Alaska Range near Broad Pass, the Talkeetna, rising in the Talkeetna Mountains, and the Yentna, having its source in the divide between the Susitna and Kuskokwim Valleys. The Chulitna River enters from the west about 80 miles north of Cook Inlet, and the Talkeetna from the northeast, about a mile below the mouth of the Chulitna. The confluence of the Susitna, Talkeetna, and Chulitna Rivers is locally known as "The Forks." The Yentna enters from the northwest, 20 miles above Cook Inlet.

All of the streams carry much sediment derived from the glaciers and from the erosion of the banks. Their currents are swift—from 4 to 7 miles an hour—and their main channels are deep and broad like the main river.

The valley of the Susitna River below The Forks, gradually broadens into a vast plain, taking in the lower valley of the Yentna. At a point opposite the head of Knik Arm it is 125 miles between the foothills.

To a large extent this area is well timbered with small spruce and cottonwood, but that portion of the valley lying west of the Susitna River below the forks of the Chulitna is a marshy plain, several miles in width, with apparently not enough supporting power to carry timber of any size.

A little above the forks the valley of the Susitna narrows, and the river is gradually inclosed between two ridges 3,000 to 5,000 feet high. Gasoline-propelled river boats ascend the Susitna at its normal or flood stages from Cook Inlet to the mouth of Indian Creek—40 miles above The Forks. A short distance above Indian Creek falls and rapids prevent further navigation of the river.

THE GENERAL ROUTE TO FAIRBANKS THROUGH BROAD PASS.

The general route up the Susitna Valley, through Broad Pass to the Tanana, was investigated by a member of the commission, who, accompanied by an attendant, left Knik on June 20. The party traveled just above timber line, over the tops of the mountains forming the eastern wall of the Susitna Valley, in order to overlook the country to be traversed by the survey.

From the top of Bald Mountain, looking due south down Knik Arm and Cook Inlet, the plain stretches out from the foothills toward the tidewater and the town of Knik. This lowland was dotted with small lakes and ponds and closely covered with spruce, cottonwood, and birch. The Government wagon road crossed this area, leading from the town of Knik to the Willow Creek mines, and the Little Susitna River flowed through in a southwesterly direction toward its mouth at the head of Cook Inlet.

After leaving Bald Mountain the party traveled almost due north, and for many miles the country along the eastern border of the valley was seen to be a low, gently rolling plain, sloping gradually from the foothills to the flats along the river bank, with here and there a small lake or marshy spot devoid of timber.

It could readily be seen that any line through this section could seek its location on practically a free grade, so little did the general elevation of the country change as it stretched north toward the Forks.

The party left the high ground on July 1 and crossed over to the site of the old trading post at the Forks—a point very near the proposed line of the survey.

It was found desirable to cross to the western bank of the Susitna River a short distance above its confluence with the Chulitna, as the country on that side was better adapted to travel with pack animals. Up to this time the numerous streams had been crossed by fording or swimming; but the Susitna in its flood stage was far too wide and swift to attempt this method. At the Kashwitna the horses swam the stream, the outfit and supplies being transferred to the opposite bank by raft.

At the Susitna Crossing a raft large enough to accommodate the three horses, men, and supplies was built from dry cottonwood, and the outfit successfully transferred to the opposite bank.

The reconnoissance was continued up the west bank.

The flat lands stretched away from the river bank on either side for several miles. At a point 18 miles above the Forks and 24 miles from Indian Creek it was necessary to leave the river bank and seek the high ground, as the foothills approached the river and made horse travel through the canyons impossible.

A view of the country, looking south from the point of hill 18 miles north of the Forks, showing the course of the two rivers and the approximate position of the preliminary line, is given (pl. 25).

The party reached the mouth of Indian Creek on July 17, and the reconnoissance was continued up Indian Creek to Chulitna Pass and through the pass up Pass Creek. Views looking south down Pass Creek (pl. 26) and looking northwest up the Chulitna Valley toward Broad Pass were taken (pl. 27).

A. RAFT LOADED WITH SUPPLIES ON THE KASHWITNA RIVER.

B. RAFT LOADED WITH HORSES, MEN, AND SUPPLIES CROSSING THE SUSITNA RIVER.

A. LOOKING SOUTH FROM POINT OF HILL 18 MILES NORTH OF FORKS.

B. MOUTH OF INDIAN CREEK.

From the head of Indian Creek, through the Chulitna Pass, the spruce timber becomes smaller and there is less of it—more open areas occur, the bunches of timber being scattered and thin. It was not possible to tell of the grade of the climb from the mouth of Indian Creek to Chulitna Pass, but the later surveys showed that a plus 1.8 per cent N. B. grade could be secured.

The party continued up the east side of the valley toward Broad Pass, from which a good view of the surrounding country could be obtained.

It was found troublesome to cross the numerous tributaries of the Chulitna, entering from the east, as these streams flowed in deep gorges, requiring a long, hard climb in and out. Party No. 6 was found in camp on the north bank of the East Fork on July 21.

It is about 10 miles to the summit of Broad Pass from the line crossing of East Fork. The spruce timber is very sparse and scattered, and the ground is covered with a thick moss.

Broad Pass forms the watershed between the Cook Inlet drainage on the south and that of the Tanana on the north. The Chulitna, flowing west, rises on the southern slope of Broad Pass and the Jack River, flowing north, crosses the eastern end of the pass to its confluence with the Nenana. After receiving the Jack River, the Nenana flows a little west of north, breaking through the mountains of the Alaska Range in deep, rugged canyons. The character of the vegetation changed perceptibly a few miles north of Broad Pass. The timber became very sparse and the rolling tops of the hills and mountains are generally quite bare except for grass.

The Alaska Range is quite wide north of Broad Pass, the mountains and foothills extending for a distance of 65 miles. At this point the great inland flats of the Tanana River are reached, and they stretch out to the north in an unbroken plain for 25 miles to the south bank of the Tanana River at a general elevation of from 400 to 500 feet above sea level.

The Nenana River, rising in the Alaska Range, carries a large volume of water, and can only be forded in its low stages. In the canyon section it is subject to extremely sudden floods. It covers a wide area between its banks below the canyon, divided into numerous channels, each carrying a little water. It is navigable for light-draft gasoline boats for about 15 miles from its mouth, and while poling boats and light canoes can be taken up the river for about 30 miles, such procedure is not found economical. The upper river above the canyon can be used in certain places by canoes or rafts, but short stretches of rapids prevent navigation for any distance. The Nenana River enters the Tanana River through many channels, forming a wide delta.

The area between parallels 64° and 66° north latitude and meridians 146° and 150° west longitude is known as the Fairbanks quadrangle. It lies in the Yukon-Tanana region, forming a part of the central plateau of Alaska, and comprises the Tanana lowland south of the river, the Tanana upland immediately north of the Tanana River, of which the town of Fairbanks is the center, and the Yukon lowland. The Tanana River for the larger part of the distance between Fairbanks and Nenana flows along the base of the highland known locally as the Goldstream Range. The mountains form the divide

between the Tanana and Goldstream, and routes were surveyed into Fairbanks on both sides of this range.

Party No. 7, surveying the Broad Pass-Jack River district, was found in camp on the south bank of the Nenana just above the mouth of Jack River on July 26, and party No. 9 at the mouth of Healy Fork on August 4.

The party of the commissioner, who had made a reconnoissance from Fairbanks across the Tanana Flats to the Hoseanna and Healy Creek district, was encountered on Moody Creek, and the two parties joined and continued down the Nenana River to the Tanana. The party was conveyed to Fairbanks by river steamer on August 9.

DETAILED DESCRIPTION OF LINE PASSAGE CANAL TO FAIRBANKS.

Station O, the initial point for the survey, is on the east border of the gravel flat known as Whittier Delta, on the south shore of Passage Canal, and about 1½ miles from the head of the bay. This flat, which is the most suitable for terminal facilities for the railroad, has about 150 acres available for this purpose and also for town-site purposes. The flat is considerably cut up by glacial streams, but these can quite easily be confined to reasonable proportions.

Whittier Glacier, the front of which lies about one-half mile south of the flat and above it, does not seem to constitute any especial menace to the locality. To make suitable terminal grounds the flat should be covered with a rock fill from 4 to 10 feet in depth, the material for which can be borrowed from the adjacent hills or hauled from the long tunnel about 2 miles away. The width of the flat, in the direction crossed by the survey, is about 3,400 feet.

Leaving the flat on a maximum rising grade of 0.85 per cent some rock bluffs are first encountered. These extend for a distance of 1 mile These bluffs are very irregular and the work, in consequence, would be heavy, estimated at 55,700 cubic yards excavation and about 120,000 cubic yards of embankment, the excess of embankment to be made from material taken from the tunnel ahead. After leaving the rock bluffs, the line crosses the upper side of a glacial flat, which extends on an easy slope to the shore of Passage Canal.

About 145 acres of this flat could be covered with a fill of 5 or 6 feet and made available for storage tracks and building purposes. Crossing this flat a distance of 2,000 feet, the line, about 2 miles from its initial point, enters a tunnel 13,005 feet in length. This tunnel is through the main ridge separating the waters of Passage Canal and Prince William Sound from those entering Turnagain Arm and Cook Inlet. The ridge rises to a height of about 3,000 feet above the grade of the tunnel. The material to be encountered is hard slate and graywacke, and will probably not require much, if any, timbering. The grade continues on the maximum of 0.85 per cent to the east portal of the tunnel, then reduces to 0.4 per cent, and continues with this maximum to a summit at the west portal where an elevation of 135.2 feet above low water is obtained. From here the line descends on a 0.4 per cent maximum to Turnagain Arm. For purposes of construction, the east end of the tunnel is easily reached from Passage Canal, while the west end has to be reached

A. COUNTRY SOUTH OF BROAD PASS.

B. LOOKING SOUTH DOWN PASS CREEK.

LOOKING NORTHWEST UP THE CHULITNA VALLEY, TOWARD BROAD PASS.

via the Alaska Northern Railroad to mile 63, and thence by about 6 miles of wagon road.

Leaving the tunnel the line crosses Bear Valley, a distance of about three-quarters of a mile, on the westerly border of which is a high rock ridge known as Turnagain Shoulder. This valley is the bed of a glacial lake, formed by the Portage Glacier resting against the end of Turnagain Shoulder, and thus forming a dam. This lake, breaking through, formed a river about 200 feet in width in front of the glacier. This river now drains the valley. The valley extends in a northwesterly direction about 2 miles and would afford a large amount of room for any storage yards if desired.

Crossing the valley, with but slight expense for grading, Turnagain Shoulder is encountered. This will require a tunnel of 4,960 feet. The rock is hard slate and graywacke and will probably require little, if any, timbering.

After leaving the tunnel, near milepost No. 6, the line follows down the valley of Portage Creek in a general westerly direction. The soil is glacial drift with many large cobbles. From mile 6 to mile 10, the line is on filling, varying from 3 to 8 feet, the material for which can be obtained from the sides adjacent. Several pile openings, varying from 75 to 90 feet in length, will be required. From mile 10 to mile 13.25 the line crosses marshy ground on an average fill of about 4 feet, the material for which will have to be hauled some distance from borrow pits established at one side. At mile 12 Twentymile River will be crossed on a pile trestle 1,260 feet in length.

At mile 13.67, from the initial point, the line encounters the constructed line of the Alaska Northern Railroad at a point 66.29 miles from Seward. This point is at the head of Turnagain Arm. From this point to Kern Creek, a distance of 4½ miles, the line follows in close proximity to the constructed line. On miles 13 and 14 several rock points would have to be cut through. In miles 14 and 15, of the present constructed line, is a trestle of about 1 mile in length, not required for drainage, but for the purpose of keeping the line above the flat and away from the snowslides, which would endanger it, were it built along the sidehill. This stretch could probably be filled to advantage. From the middle of mile 15 to the beginning of mile 16, the line passes over some mud flats and occasionally strikes a few rock points which jut out. Several openings are required for drainage. Through mile 16 and to mile 18, at Kern Creek, the line follows the northern slope of the hills, cutting through many rocky points and filling across short embayments.

At Kern Creek, mile 18.2, the survey leaves the end of the track of the Alaska Northern Railway. Some grading has been done in scattering localities ahead of this point, but nothing continuous. Such grading as has been done could be taken advantage of to a limited extent.

After leaving the junction with the Alaska Northern Railway near mile 13 plus, the grade is an undulating 0.4 per cent maximum. If it is desired to use the existing grade of the Alaska Northern Railway, a few stretches of 0.5 and 0.6 per cent would have to be used. This would be against traffic going north and would be no serious detriment to operation.

From Passage Canal to Kern Creek very little clearing would have to be done. In the swampy districts the country is in places covered with a growth of light brush, but no timber of any size is encountered.

From Kern Creek the line follows along the north shore of Turnagain Arm, a distance of 33 miles, to mile 51. Here is encountered the heaviest continuous construction on the whole route. Although occasionally for short distances a bench occurs on which the line can be placed with easy construction, for the most part it has to be benched in on heavy transverse slopes. The contour of the country is very irregular, making it impossible to follow the same, even with very sharp curvature. As a matter of fact, the use of sharp curvature does not help matters much, consequently nothing sharper than 10° curves have been used, and these sparingly.

In many cases deep embayments and gulches occur, and in order to save extravagant cutting of either bank it will be necessary to make heavy fills, taking care that the slopes do not extend far enough toward the water to be endangered by the heavy tides which occur in Turnagain Arm.

In some cases it will probably be advisable for the first construction to trestle across these places, leaving the filling to be done by train at some future date. As far as possible, all cuts will be taken out to grade on the lower side, or "daylighted," as it is frequently called. This facilitates the handling of earth or snowslides.

Generally speaking, all cuts over 3 or 4 feet in depth are solid rock. This is somewhat of an advantage, as it enables the cuts to be taken out at a slope of from ¼ to 1 or ½ to 1, whereas if they were earth, necessitating a slope of 1 to 1, the excavation would be enormous, because of the steep transverse slopes. This rock is mostly a hard blocky slate with some quartzite dikes.

As a slight relief in this rugged country, we find miles 22 and 23, at Glacier Creek, to be on flat slopes and of easy construction; also short distances in miles 28, 30, and 32. Near Indian Creek, in miles 36 and 37, we find about 8,000 feet of easy construction. Also at Rainbow Creek, miles 40 and 41, the construction is quite easy. The bridging between Kern Creek and mile 51 is not very formidable, most of the small streams and gulches being crossed by timber trestle in heights varying from 10 to 60 feet and in lengths from 90 to 392 feet. Exceptions to this are Bird Creek, in mile 34, and crossing a corner of Turnagain Arm, in mile 37, where some short spans will be required. A good many timber culverts or small openings will be required. South of Kern Creek it is not probable that any snowsheds will be required, but north of this point, especially between miles 19 and 31, it is probable that considerable protection of this kind will be necessary. These sheds will have to be of very substantial character to withstand the shock from the slides which frequently start from a long distance up the mountainside.

It is estimated that a minimum distance where snowsheds would be required is 8,855 feet, the probable cost of which would be between $500,000 and $700,000.

The grading and bridging for the 33 miles from Kern Creek to the point of leaving Turnagain Arm would cost about $77,000 per mile. This is exclusive of any snowshed construction or track. On this division there is considerable available timber to be found at

REABURN'S CAMP, MIDDLE FORK, CHULITNA RIVER.

several points, more particularly at Glacier Creek, Bird Point, and Bird Creek. Probably enough can be found to supply the necessary ties and smaller bridge timbers necessary for the construction of this division. Construction equipment and material can be landed from light-draft boats at various points along Turnagain Arm in close proximity to the work. Water for locomotive purposes is plentiful.

Leaving Turnagain Arm at about mile 51, the line turns toward the north and runs in quite a direct line toward the summit opposite Ship Creek. The curvature is easy and the grades light, the minimum of 0.4 per cent in both directions being maintained. Some reduction in cost of construction may be obtained by increasing the grade going north to 0.6 per cent maximum, and it may be found advisable to do this.

The character of the country changes and instead of the steep rock bluffs we have easy slopes and much flat country. Swamps are plentiful, notably between miles 54 and 61. The country is mostly covered with a growth of small spruce and birch, there probably being enough of the former to furnish the necessary ties. Considerable piling can be procured in places. In most places the ground is covered with a growth of moss from 1 to 2 feet in thickness. The line will be mostly in light filling except for the occasional ridges which are crossed. In many cases these fills can be made by scraping material from the sides, in which case the moss should be stripped off and the fill built on the underlying soil. In the cases of the swamps where the fill is usually deeper, and where the material will probably have to be brought by train haul from the neighboring gravel hills, it will be best to leave the moss undisturbed as far as possible. This occurs frequently between miles 54 and 61.

Several small creeks are crossed before reaching the summit, the principal ones being Chester and Ship Creeks. The former is crossed on a fill about 12 feet in height. At the crossing of Ship Creek, while the creek itself occupies but little space, there is a valley 2,200 feet across and 30 feet deep, most of which can be filled. The summit is reached at mile 64.65 from Passage Canal at an elevation of 238 feet.

From mile 51 to 64.65 the grading and bridging will average about $15,200 per mile. Construction equipment can be landed at Ship Creek and thence over newly constructed wagon roads to the work. Plenty of water is available for locomotive use.

From the summit the line descends with a 0.4 per cent maximum grade to Eagle River at mile 71.8, where an elevation of 181 feet is reached. While the general character of the country is similar to that between miles 51 and 64, in that the formation is mostly gravel overlaid with 1 to 3 feet of moss, and with scarcely any surface indications of rock, it becomes more broken and irregular. The ridges are more frequent and higher and the depressions somewhat more formidable. It is still covered with a growth of small spruce and birch. The cost of grading and bridging will be considerably increased, averaging about $26,500 per mile. There will be but little side borrowing of material, the cuts as a rule being sufficient to make the fills. A small percentage of the timber will be suitable for construction purposes. Quite extensive forest fires have

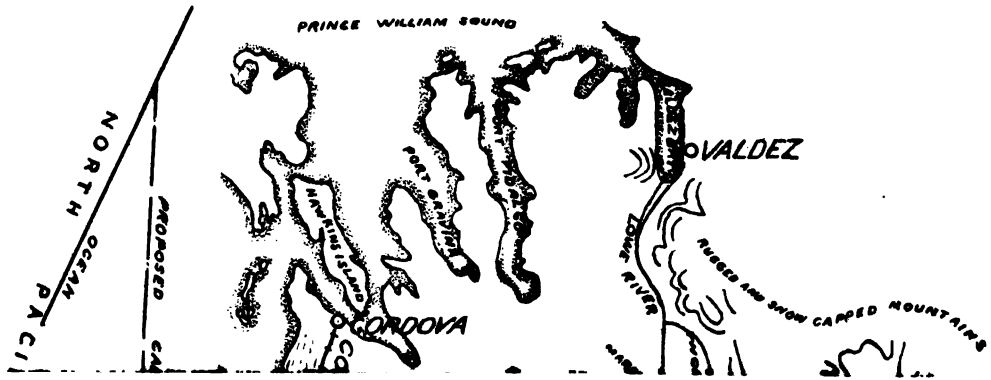
passed over much of this region. No streams of size are crossed, but numerous small culverts will be required for drainage. Eagle River is crossed with a 120-foot Howe truss span and 532 feet of approach trestle.

Leaving Eagle River, the line ascends with a 1 per cent grade a distance of 2,500 feet to a controlling gap in a ridge. Leaving this gap at an elevation of 208 feet the line descends on a 0.4 per cent maximum grade to mile 84, where an elevation of 58 feet is reached. This section is less broken and the construction consequently lighter, averaging about $12,500 per mile. The same general character of country continues. From mile 84 the line rises on a 1 per cent grade with easy support to the crossing of the Eklutna River at mile 85.4. This crossing is made by two spans of 50 feet and 130 feet, at an elevation of 128 feet. A lower crossing could be made, but the river spreads very rapidly into a glacial delta immediately below the crossing selected, thereby necessitating a much longer crossing and one much more difficult to maintain. Immediately south of the river the character of the soil changes and rock is encountered near the surface. Construction material can be landed at various points along the south shore of Knik Arm and hauled a short distance to the work.

Leaving the Eklutna the line descends on a 0.4 per cent maximum grade to near the Knik River at mile 90.5. In this distance the material is practically all rock, the line for about 2 miles being supported along the edge of rock bluffs, and the remainder of the distance being on easier slopes with rock very close to the surface. The construction therefore is quite heavy, averaging $63,000 per mile for the 6½ miles.

The Knik River, having its source at the Knik Glacier, carries at times large quantities of water. This necessitates a bridge of three 120-foot spans and about 462 feet of trestle. This river marks the southerly boundary of the flats at the head of Knik Arm. After crossing the river the grade drops to within 4 or 5 feet of the ground level to an average elevation of 48 feet and continues to the crossing of the Matanuska River at mile 92.5. The material is glacial silt and gravel. Scattering thickets of small spruce and alder alternating with open spaces are found. Several sloughs are crossed, necessitating pile openings. At the Matanuska River three 120-foot spans and 812 feet of pile trestle will be required. Leaving the river the line continues across the flats on a low embankment with a few pile openings to mile 96. From the Knik River to mile 96 the embankment will have to be constructed mostly by train haul. The average fill per mile is 25,000 cubic yards. Leaving the flat at mile 96 the line ascends on a 1 per cent minimum grade to mile 104, thence level to 105. The construction will be fairly heavy, the line in many places being supported on transverse slopes of 20° to 35°.

The country is of a similar character to much of that south of Knik Arm, the soil being gravel with a light covering of loam. Birch, spruce, and cottonwood timber is plentiful, some of which is large enough for ties. The average amount of material to be moved is about 33,000 cubic yards per mile, this being mostly gravel with a small amount of loose rock. Construction equipment can be landed at the head of Knik Arm and hauled a short distance to the work.


PRINCE WILLIAM SOUND
NORTH OCEAN PACIFIC
PROPOSED
HINCHINBROOK ISLAND
PORT CHALMERS
VALDEZ
CORDOVA
RUGGED AND SNOW CAPPED MOUNTAINS

From mile 105, at the Knik-Willow Creek wagon road, to mile 112, at the crossing of Little Susitna River, the line runs in a general northwesterly direction, crossing gently undulating ground, with grades not exceeding 0.6 per cent. The embankment is in excess, requiring some borrow, the quantities averaging about 20,000 cubic yards to the mile. In mile 108 the crossing of Swamp Creek requires a pile trestle 691 feet long, at an average height of 40 feet. The descent in miles 111 and 112 to cross the Little Susitna River is made on a —1 per cent grade. The crossing requires 110 feet of approach trestle and a 100-foot through Howe truss wooden span. The grade is level for a short distance north of the bridge.

From mile 112 to mile 120 the line is laid along the south base of Bald Mountain, at an elevation of from 325 to 400 feet above sea level. A few heavy cuts are encountered; the quantities average about 27,000 cubic yards to the mile. The only bridge required is at the north end of mile 115, where a frame trestle 30 feet high and 387 feet long is called for. The maximum grade used is +0.84 per cent N. B.

From mile 121 to mile 130, at Willow Creek, the line swings around the southwest base of Bald Mountain, and from elevation 400 feet at mile 120 the grade rises to elevation 525 at mile 123 on a +1 per cent and drops again on —1 per cent grades to elevation 295 at Willow Creek. In miles 125 to 130, inclusive, the excavation and borrow is somewhat heavy. The average for the 10 miles is 28,400 cubic yards. The bridging on this section is light; there is one short trestle at Deception Creek, mile 128, and 110 feet of approach trestle to the 100-foot Howe truss span, mile 130. From Willow Creek at mile 131 to the Kashwitna River at mile 144, the line holds a general northerly direction. It lies along the toe of the foothills, about 7 miles from the east bank of the Susitna River. Maximum grades of 1 per cent in both directions are used. The grade reaches an elevation of 392, mile 139, and drops to 300 at the Kashwitna River. The grading quantities, including borrow, average 19,800 cubic yards per mile. There is a pile trestle 193 feet long in mile 132, and a bridge over Little Willow Creek, consisting of 110-foot approach trestle and one 100-foot through Howe truss wooden span. The Kashwitna is crossed on two 100-foot through Howe truss wooden spans, with 167 feet of approach trestle.

The line north of the Kashwitna bears a little to the west of north and approaches closer to the Susitna River. At Montana Creek, mile 156, it is about 2½ miles from the east bank. From mile 145 to 155, inclusive, the grading is light, averaging about 10,000 cubic yards to the mile. The crossing of Montana Creek, mile 156, is about 25 feet high, and it requires about 50,000 cubic yards to make the embankment.

Montana Creek is spanned by one 100-foot through Howe wooden truss, with 193 feet of approach trestle. The same length of trestle is required crossing Sheep Creek, mile 151. The grades on this section are comparatively light, being about 0.5 per cent in both directions. They hold a general elevation of about 350 feet.

From mile 157 to 160, inclusive, the grading averages 23,000 cubic yards per mile; mile 165 and 166 average 13,000 cubic yards per mile, being mostly borrow for low embankments. Miles 167, 168, and 169

average 45,000 cubic yards per mile. Miles 170 and 171 average 16,000 cubic yards per mile. There are two small trestle bridges in this section, one in mile 164 and one in mile 165; 1 per cent grades in both directions are used in miles 167 and 169 to reduce quantities. The line lies along the east bank of the Susitna River, miles 168 to 170, and crosses the Talkeetna River in mile 171, about 1 mile above the Forks. The south channel is crossed on a 120-foot through Howe truss wooden span, and the north channel on two 100-foot through Howe truss wooden spans; the approach trestles and the trestle across the island connecting the two spans have a total length of 3,238 feet.

From mile 173 to 186 the grading is comparatively light, averaging 18,500 cubic yards per mile. About 10,000 cubic yards per mile would be secured from side borrow pits. There are no bridges on this section. The line holds very close to the east bank of the Susitna River from mile 177 to 186. The grades are very light; there is a + 0.48 per cent and a + 0.81 per cent grade in miles 178 and 179.

General remarks, section, mile 105 to 186.

The entire 81 miles of this section is closely timbered with small spruce. The growth is not large, but it would do for crossties and some of the shorter piling. Timber-box culverts would be used for all openings not requiring open trestle bridges.

Water supply for locomotives could be obtained at almost any point along the line, as there are innumerable streams on this route.

This section could be attacked for construction work at several points. Construction supplies could be delivered at the town of Knik and from there hauled by wagon over the Government wagon road, 14 miles to the line, at mile 105, or lighters could be used and supplies delivered up one of the sloughs at the head of the Knik Arm. From mile 105 to 130 construction supplies could be delivered by building a summer corduroy wagon road along the right of way connecting with the Knik wagon road, or supplies could be hauled in winter by sled transportation. From mile 130 to 186 the line could be made accessible to the Susitna River by building short connecting wagon roads. Some of the tributary rivers like the Kashwitna permit small gasoline boats or lighters to ascend the stream a short distance. The supplies could be handled in the summer season by the water route to points on the bank and distributed during the winter months by horse sleds over the snow. The average construction cost for these 81 miles is approximately $28,000 per mile.

From mile 186 the line leaves the flat land and follows the toe of slope along the hills east of the Susitna River to mile 210. It holds very close to the river edge, and in one or two places it is necessary to pass over short sections of the river bed in order to maintain the alignment and grade and avoid heavy cutting. The water grade of the Susitna River at this point is only 0.2 per cent, and the railroad grades exceed this by only a small amount.

There are very few bridges in this section. The Susitna River is crossed in mile 210 just below Indian River on a five-span steel bridge 791 feet long, estimated to cost $255,000. The bridge is projected at elevation 750, 21 feet above high water.

The average amount of grading for the first 15 miles is 11,000 cubic yards (embankment) per mile. In several places along the

A. PARTY NO. 6, MIDDLE FORK, CHULITNA RIVER.

B. LOOKING WEST ACROSS CHULITNA VALLEY FROM HONOLULU CREEK.

A. HILLS EAST OF NENANA RIVER, NORTH SLOPE OF ALASKA RANGE.

B. CONFLUENCE OF NENANA AND TANANA RIVERS.

river the line is supported on steep rock cliffs, where construction costs will be heavy. In miles 187, 190, 191, 197, 203, and 204 the average per mile will be 30,000 cubic yards of solid rock.

From mile 210 the location ascends Indian River, following the west side to mile 212.2. It then crosses the river and follows the east side to mile 214.1. In mile 214 an 880-foot tunnel is located to avoid the sharp curvature in the rocky canyon. This tunnel is in firm rock and probably will not require much timbering. The line then follows close to the base of the mountain on the west side of the creek and reaches Chulitna Pass, elevation 1,360, at mile 218+1.6 per cent and+1.7 per cent grades are used. The grading averages 40,000 cubic yards per mile, of which 4,000 cubic yards would be borrow and 36,000 cubic yards from main-line cuts. The two crossings of Indian River in miles 212 and 214 require 345 feet of wooden bridges and a small 42-foot bridge is required in mile 218.

From Chulitna Pass, mile 218, the location continues up Pass Creek on a 1.5 per cent grade to mile 222.5 at elevation 1,650. It then swings to the northwest and passes along the southwest slope of the ridge, reaching an elevation of 2,000 feet on the bench east of the Chulitna River at mile 227. A grade of 1.5 per cent is used. At mile 229.3 Hurricane Gulch is crossed by a steel bridge 300 feet high and 650 feet long, estimated to cost $228,000. The excavation quantities from mile 219 to mile 229, inclusive, average 14,000 cubic yards per mile, including the 16,000 cubic yards necessary to borrow in order to make the fills. There are five small wooden trestle bridges, totaling about 686 feet.

From Hurricane Gulch, mile 229, the line continues approximately along the 2,000-foot level, crossing Little Honolulu Creek at mile 232.3 on a steel bridge 660 feet long and 125 feet high, estimated to cost $115,000.

Bear Canyon is crossed in mile 233 on a frame trestle 364 feet long, and Honolulu Creek is crossed in mile 235 by a steel viaduct 620 feet long and 90 feet high, estimated to cost $107,000.

In mile 235 there is a frame trestle 350 feet long, and north of this point several small streams are crossed on pile trestles. There are two tunnels in mile 235; one in earth, 200 feet long, will have to be timbered throughout; the other, 900 feet long, is in solid rock and will not require timbering. In mile 236 there is a tunnel 620 feet long, which will probably have to be timbered. Hardage Creek, in mile 241, is crossed by a frame trestle 596 feet long and 75 feet high, supported on piling. There are three other rather high frame trestles south of East Fork, one in mile 242, 182 feet long; one in mile 244, 308 feet long; and one in mile 246, 126 feet long. East Fork is crossed in mile 246 by a steel viaduct 460 feet long, with an average height of 65 feet. It is estimated to cost $80,000. It is now located on a curve, but it is believed that the bridge can be put in on a tangent.

The cost of bridging in this 18-mile section is very heavy. The glacial streams have eroded deep valleys, which extend for many miles above the line crossing. It would not be practicable to put in development at these crossings in order to bridge the stream at a lower elevation on account of the nature of the steep gravel banks.

Mile 244 to East Fork the line follows the east wall of the river, and in this section the work is very heavy. The quantities—miles 229 to 246, inclusive—average 30,000 cubic yards to the mile, largely solid

rock and frozen earth; —1.25 per cent and +1.5 per cent grades are used. The grade rises to an elevation of about 2,200 in crossing from East Fork, mile 246, to Middle Fork, mile 253, using 1.5 per cent grades in both directions; the line ascends to the summit of Broad Pass, mile 256, elevation 2,400, on 1.5 per cent grades. The grading in the last 10-mile section will be comparatively light. The line is held on fairly even ground through the pass. It crosses the Middle Fork of the Chulitna in mile 253 on a wooden bridge 588 feet long. There will be about 11,000 cubic yards of excavation and 1,500 cubic yards of borrow per mile on this section.

The mountain gap of Broad Pass is 6 to 8 miles wide by 20 to 25 miles long. It is partially timbered with scattering spruce and the ground is marshy and covered with moss and dotted with numerous small lakes. The spruce timber stands more closely together south of Chulitna Pass and along the Susitna River south of Indian Creek; this southern part would probably furnish sufficient crossties and telegraph poles for the railroad; some short piling might also be obtained.

Sufficient sand and gravel can be found along the rivers and creeks for construction purposes. The entire section is well watered by numerous streams, and in many cases gravity water supply could be secured. The average cost for the 71 miles, miles 186 to 256, is $51,990. The cost of bridging in the Chulitna Valley section and the allowance made for frozen ground tends to make this figure high.

From the summit of Broad Pass, mile 260, the line drops down the north slope of the pass on a grade of —1.4 per cent and crosses the Jack River in mile 269. The territory traversed comprises the land between the Cantwell and the Jack River and consists of several long, low summit ridges running longitudinally through the pass. Between the ridges are marshes and lakes. In general, the ridges are covered with buckbrush about 3 feet high and with tundra about a foot thick. After crossing the Jack River the line finds support on the high hills east of the river to mile 270.

In this distance of 11 miles, the line is laid in embankment which could be made from side borrow pits or from train haul, preferably the latter, to avoid disturbing the frozen ground. The quantities for this 11-mile section average 20,000 cubic yards per mile. There are no signs of deep snow anywhere in Broad Pass.

From mile 271, the line drops down Jack River and crosses the Nenana River in mile 275 on a steel bridge 430 feet long, estimated to cost $120,000.

In the south approach to the bridge, +1 per cent grades are used, the quantities averaging about 24,000 cubic yards per mile, including a total of 30,000 cubic yards of solid rock. In the 4 miles, 275 to 278, inclusive, the line is benched in at the foot of the mountain slope. The average per mile is 40,000 cubic yards, with about 15 per cent solid rock. In miles 273 and 274 and again in miles 279 to 285, inclusive, the line is laid in embankment along the flat lands bordering the Nenana River. The grades in this section are generally light; —1.4 per cent grades are used in mile 276 and —1.1 per cent grades are used in mile 279.

From mile 286 to 291, inclusive, the line leaves the flats and is laid through some rolling country, the grade rising 131 feet between 286

A. CROSSING OF EAST FORK.

B. BROAD PASS LOOKING NORTHEAST.

BROAD PASS LOOKING SOUTH FROM THE HILL NORTH OF JACK RIVER.

and 288 on a 0.9 per cent grade and dropping again to the same elevation at the Nenana River on —1.05 and —1 per cent grades. The work on this section is not very heavy, averaging but 25,000 cubic yards per mile, 50 per cent of which is borrow.

From mile 286 to 305 the Nenana River flows in more or less of a canyon; it is very crooked, with cut banks nearly the entire distance. The depth of the canyon varies from 100 feet at mile 286 to 300 feet at mile 305. The river has a fall of 20 to 40 feet per mile, with a flow of about 25,000 second-feet in low-water stages and several times that amount in flood stages. It is a very dangerous river, the current runs about 12 feet per second, and there are not very many stretches of slack water. About every half mile the river plunges along over bowlders in white rapids. It is from 200 to 300 feet wide and reaches a depth of from 10 to 12 feet. The walls of the canyon are swept clear by high winds. The line was laid, as far as possible, entirely away from the action of this river. The river is crossed in mile 291 in order to reach more favorable ground on the west bank. The crossing is high and expensive. It required a steel viaduct 1,300 feet long, at an average height of 70 feet, the estimated cost of which is $458,000.

From mile 292 to Riley Creek (mile 296), inclusive, the line is laid along the high table-lands bordering the west side of the Nenana River. The general alignment is good and the work is light for the character of the construction. The elevation drops 250 feet in this section, with maximum —1.1 per cent grades. The excavation averages 24,000 cubic yards per mile. There are three or four short trestle bridges in miles 293, 294, and 295. The crossing of Riley Creek, mile 296, requires a steel viaduct 540 feet long and 95 feet high, with 500 feet of approach trestle averaging 45 feet in height, estimated to cost $198,000.

Miles 297 to 305, inclusive, the line holds between elevation 2,350 and 2,400. In both directions 1 per cent grades are used. The grading work is light, averaging 21,000 cubic yards for the 9 miles; the bridging in this section is extremely heavy, due to the wide, deep canyons it is required to cross. A frame trestle 350 feet long and 55 feet high is required at mile 297, and a frame trestle 285 feet long and 70 feet high is required at mile 298. In mile 299 there are two frame trestles totalling 276 feet. In mile 300 there is required a steel viaduct 390 feet long and 120 feet high, estimated to cost $67,000. In mile 301 there are two steel viaducts, one of which is 280 feet long and 100 feet high, estimated to cost $42,000, and the other 505 feet long and 150 feet high, estimated to cost $113,000. In mile 302 there is a frame trestle 406 feet long and 60 feet high. In mile 303 there is a pile or frame trestle 280 feet long and 60 feet high. There is also a small pile trestle in both miles 304 and 305. This section is benched in on the mountain sides, 300 feet above the river, with transverse slopes of 20° to 40°. The surface is covered with alder brush, spruce timber, and some rocky fragments. There is vegetation throughout and no solid rock slopes are encountered. The grade line was set to agree with the elevation of the table-lands between miles 301 and 305. The locating engineer reports that the high crossing of these numerous mountain drains are unavoidable.

From mile 306 to 309 the line drops down on heavy grades from elevation 2,400 to 2,100 on —1.8 per cent grades. The maps show

this grade can be reduced by locating over a slightly different route. The average grading per mile of this section is 30,000 cubic yards. A good deal of time and study should be given to the location through the Nenana Canyon district in an effort to reduce the cost of bridging.

Several alternative routes which are indicated on the general maps should be thoroughly investigated before the line is finally located.

From mile 310 to mile 313, inclusive, the line drops down from the tableland west of the Nenana River on — 1.8 per cent grades to a crossing of the Nenana in mile 313. The quantities average 28,000 cubic yards per mile. It is quite possible that the grade on this slope can be reduced by more development. The crossing of the Nenana River from the west to the east bank in mile 313 is made on a bridge 678 feet long, consisting of one 240-foot steel channel span and approaches, the estimated cost of which is $232,000.

From mile 314 to mile 320, inclusive, the line follows down the east bank of the Nenana River, along the toe of the slope of the ridge. The material in this ridge, from surface indications, is mostly gravel. The profile of the locations secured is comparatively regular, although several rather wide, deep valleys are crossed, which brings up the general average per mile. There is one short 210-foot trestle over the Hoseanna Creek in mile 314. From mile 321 to mile 340, inclusive, the line is laid a little farther away from the east bank of the river, but it continues to follow the foot of the ridge. The ridge is not quite as high, however, as in the upper section. There are several miles in this district where the grade line is laid a few feet above the ground; the embankment would be made from side borrow pits or by train haul. The grades are generally light. There is a short section of 0.9 per cent grade used in mile 334, but this can be reduced. The quantities for this 27-mile section average 25,000 cubic yards to the mile.

Additional surveys should be made from mile 310 down the west side of the Nenana River along a line of low benches to a crossing of the river at some point farther down stream. It is possible such surveys would develop a cheaper and better line.

The line reaches the south edge of the great Tanana lowlands at mile 340, and from this point to mile 363, near the south bank of the Tanana River, the line is laid in embankment the entire distance, averaging about 12,000 cubic yards to the mile. The material for filling purposes would be secured from side borrow pits, or by train haul. For 3 miles the line is comparatively close to the Nenana River, but at mile 346 the Nenana River turns toward the northwest and the location follows across the flats along the east side of a slough known as Seventeenmile Slough, which joins the waters of the Tanana and Nenana Rivers. Five per cent grades are used in this flat section.

In mile 364 the great Tanana River is crossed on a bridge 3,600 feet long, including trestle approaches. This bridge will be a concrete and steel structure having four spans of 225 feet each. The second span from the south bank of the Tanana will be of the vertical lift type with a high-water clearance of 60 feet. The clearance of the span in rest will be 20 feet above high water which will allow of the passage of the launches and the smaller steamers plying on the Tanana. The estimated cost of this structure is $611,000. The grade

A. VIEW LOOKING DOWN NENANA RIVER, SHOWING MOUTH OF JACK RIVER.

B. RAFTING NENANA RIVER, 1 MILE ABOVE JACK RIVER JUNCTION.

is set at an elevation of 444, which requires +0.7 per cent grades in the south approach to the bridge. The north approach leads off on a light grade to solid rock ridge on the north side of the Tanana.

From mile 365 the line swings around the west point of Goldstream Ridge, separating the waters of the Tanana from the valley of Goldstream Creek. The grading in mile 365 is very heavy, being 71,000 cubic yards of solid rock excavation, including the heavy cut approaching the bridge.

From mile 367 to mile 383, the line is laid at the foot of the northwest slope of the Goldstream Ridge along open, grassy plains, and niggerhead swamps. It is carried mostly on embankment, the grade being laid very close to the ground. The country is sparsely covered with small willows and scrub spruce. In mile 373 Little Goldstream is crossed with a small opening, and in mile 383 Maiden Creek is crossed on a low, pile bent trestle 826 feet long. From mile 366 to mile 383, inclusive, the grading averages 16,000 cubic yards per mile.

From mile 384, the line follows up Goldstream. It is carried along the north face of the ridge and the excavation is heavy compared to the flat section just described. From mile 384 to 386, inclusive, the quantities average 49,000 cubic yards per mile.

From mile 387 north the grading is much lighter until mile 394 is reached. The quantities from mile 387 to mile 393, inclusive, average 22,000 cubic yards to the mile, and from mile 394 to mile 398 they average 32,000 cubic yards to the mile.

From mile 399 to 407 the line continues up the south side of Goldstream. The ground slopes more gently toward the river bank, and there are many swamps. The quantities average 17,000 cubic yards to the mile.

From mile 408 to 411 the slope of the ridge along Goldstream is quite precipitous. The line is benched in on these slopes close to the river. The quantities average 61,000 cubic yards to the mile.

In mile 411 the line turns toward the south and reaches the track of the Tanana Valley Railroad in mile 413, 7 miles from Fairbanks. No rockwork is anywhere apparent along Goldstream.

Additional surveys should be made down the north side of Goldstream before the definite location of a line can be determined in this valley.

Alternate lines near Fairbanks.

There were three lines surveyed from Nenana to Fairbanks, namely, the Goldstream line, the north-bank line, and the south-bank line.

The Goldstream line follows around the north side of the Goldstream Hills and ascends Goldstream Creek to mile 7 of the Tanana Valley Railroad, connecting with Fairbanks. A detailed description of the line is given elsewhere.

The north-bank line leaves the north end of the Tanana River bridge and follows the base of the hills from Nenana to Chena, which is the terminus of a spur of the Tanana Valley Railroad, 9 miles from Fairbanks. For many purposes this is a good line. While more expensive to construct than the Goldstream line, there should be little trouble in maintenance, as the line is largely supported on dry hillsides with a southern exposure; snow, under the influence of the spring sun, will quickly disappear. The accessibility

of this section to water transportation will render construction a comparatively simple matter. There is little probability of improvement along this line, except in the matter of hillside farming, for which the country is favorable.

The south-bank line crosses the Tanana River below Chena and continues down the south bank to a connection with the trunk line near mile 61, 2½ miles south of Nenana. The country south of the Tanana River between Nenana and Fairbanks is a vast swamp, and while a line on the south bank would avoid the heavy work required along the north bank, it is not to be recommended. There are numerous pile bridges which would be subject to washout by floods, and their renewal in the frozen subsoil would be a constant source of trouble and expense.

Trial line, Fairbanks to Tatlanika River and Healy Fork.

The commissioner in charge of the work at the northern end of the line had his attention called to the possibility of extending a line from the northern slopes of the hills of the Alaska Range directly across the Tanana lowland to Fairbanks. In order to thoroughly investigate the merits of this route, he made a personal reconnoissance of the line and put a locating party into the field to run a preliminary line from the Nenana River up Hoseanna Creek for the purpose of developing the divide separating the headwaters of the Healy Fork and Lignite Creek with those of the Totatlanika and the Tatlanika Rivers. Forces were in the field on this work from July 5 to August 4. These surveys showed that the route was not a practicable one on account of excessive grades and construction costs. Upon completion of the north-bank survey a party was put into the field at Fairbanks, and they produced a tangent 8 miles in the direction of the Tatlanika. It was found that the crossing of the Tanana River at Fairbanks would require a very long and expensive bridge, and this fact, coupled with the information obtained by party No. 9, caused the line to be abandoned August 10.

BRANCH LINES.

(*a*) *Spur to Matanuska coal fields.*

The most important branch line in the western division would be the spur to the Matanuska coal fields. This line leaves the main line at mile 94.46 from Passage Canal or mile 147.08 from Seward and extends in an easterly direction up the Matanuska and Chickaloon Rivers a distance of 38.45 miles to the Chickaloon coal camp, situated in the best-known part of the coal fields.

For convenience in the description of this line, we will start at Chickaloon and run west, this being the direction of the heavy tonnage. Chickaloon is situated in a gravel flat about 3,500 feet in length and 500 feet in width at an elevation of 983 feet above sea level. In the ridge immediately adjacent on the crest are the coal veins from which the coal recently tested by the Navy Department was taken. Coal croppings are seen in almost every direction. The line starting from the northerly extremity of the flat follows down

the north bank of the Chickaloon River to its junction with the Matanuska River at mile 2.6 and thence down the north side of the latter to mile 30.7.

The maximum grade used is 1 per cent eastbound and 0.4 per cent westbound. For the first 1½ miles the construction is light, being mostly in light filling, with an occasional cut through a gravel point. In the next half mile two high shale points are cut through, necessitating moving a considerable amount of material. At mile 2½ a high sandstone point is encountered. From here to mile 7 the work is of a medium character, the line being largely in light filling, with frequent cuts through low sandstone points. From mile 7 to mile 28.5 the line, in general, is either on flat, timbered benches above high water or on low bars which overflow during high water or in the river. The Matanuska River, at points where the line is located on ground subject to overflow, runs between shale bluffs from 1,000 to 6,000 or 7,000 feet apart. These bluffs are from 150 to 250 feet high. They are, for the most part, a partially disintegrated shale, with a nearly vertical dip, and are badly shattered. If cut into, immense quantities of material would have to be moved and there would always be great danger of slides. It is not deemed advisable to construct a line along these bluffs, so wherever they come down abruptly to the river the line is thrown out somewhat into the stream, and it is contemplated to build sheer dams to deflect the current and to form a new channel. There being very little rock suitable for rip-rap in this vicinity, it will be necessary to build these dams often enough to keep the water well away from the roadbed.

A careful study of the action of the river should be made in the spring, when the ice moves, and also during the summer high water, in order to determine the nature and location of these dams. From mile 28.5 to 30.7 the line supports up a high gravel cut bank, the traverse slope being from 20° to 35°. This gravel, although somewhat cemented, scales appreciably during the windy season, so it will be advisable to cut into the slope as little as possible. The line, therefore, should be built largely with borrowed material. The ascent is made with a 0.4 per cent maximum grade.

From mile 30.7 the line descends in a 1 per cent grade over easy slopes and with light work to a connection with the main line at 38.45. Most of the country, with the exception of the low gravel bars, is covered with a growth of small spruce, birch, cottonwood, or alder. Probably enough ties can be obtained to half tie the line. Several sizable streams are crossed, namely, Kings River, in mile 14, requiring a structure 225 feet in length; Granite Creek, in mile 18, a structure 90 feet in length; and Moose Creek, in mile 26, requiring a structure 140 feet. At Eska Creek, mile 21, a channel change is contemplated and a short structure will be required.

The total cost of the line from Chickaloon to the junction at mile 38.45 is $1,766,686.

(*b*) *The Kuskokwim branch.*

The reconnoissance made by party No. 11, under Mr. J. L. McPherson, from the Susitna Valley through the Kuskokwim Valley to Iditarod, has been briefly referred to on page 14 of this report. The party

covered a distance of 726 miles and reported on possible routes involving 423 miles of railroad construction, estimated to cost $17,790,-723. Mr. McPherson's complete report will be found in Appendix F.

(c) The Ship Creek branch.

The nearest point on the seacoast from which the products of the Matanuska coal fields can be shipped is Ship Creek. As stated elsewhere, this is the head of navigation for ocean-going steamers in Cook Inlet. From the coal fields to Ship Creek is 74.9 miles. The maximum grade out—that is, against the coal traffic— is 0.4 per cent; that into the coal fields is 1 per cent.

A line from the water front at Ship Creek would reach the main line at mile 62.92 from Passage Canal (mile 115.54 from Seward) in a distance of 4.89 miles. The construction would be easy, the material being mostly gravel. The estimated cost of this line, including track, but not including any terminal facilities at Ship Creek, is $123,635. Even were Ship Creek not used as a shipping point, it would be advisable to build this line for convenience in hauling construction material, should it be desired to use the western route. A further description of this point as a harbor appears elsewhere. (See Harbors.)

RESOURCES OF TRIBUTARY COUNTRY.

In descriptions of resources which may furnish traffic revenue to any contemplated system of railroads it must be taken into consideration that this commission does not claim an accurate personal knowledge of the various developments and resources of Alaska. The opinions of the members have been largely formed, in addition to their personal observations, by examination of reports of the various government bureaus, data compiled by chambers of commerce, and statistics furnished by existing transportation companies. The commission attempts to give an unprejudiced, conservative opinion throughout of present operations and possible development of the country to be traversed by suggested lines of railroads.

As the mining district in the vicinity of Fairbanks is tributary to both the eastern and western routes, one description of this territory will suffice in the consideration of either system.

FAIRBANKS DISTRICT.

Fairbanks, an incorporated town, with a permanent population of approximately 3,000 people, and a tributary population of an additional 3,000, is situated on Chena Slough of the Tanana River. Except in extremely low water, it is served by sizable river steamers. At low water several bars between Fairbanks and Chena render navigation difficult and at times impossible. The larger part of the town is built on an island, connected to another island by a bridge. The bridge is maintained by popular subscriptions and by the proceeds from a ferry operated when the bridge is broken out by the


Kateel R.
Nulato
Wireless Sta.
Kaltag
Khotol R.
Iditarod

ice and drift of the spring floods. The Tanana Valley Railroad connects Fairbanks with Chena, 9 miles away, at the mouth of the slough. From Fairbanks the road runs about 40 miles into the mining district, with a terminal at Chatanika, on the Chatanika River, near the mouth of Cleary Creek.

Fairbanks is a prosperous community, generously endowed with civic pride. It maintains well equipped schools, hospitals, churches, a public library, banks, hotels, wholesale and retail stores, central heating and lighting systems, water works, telephones, and many other conveniences of modern towns. It is the administrative headquarters of the fourth judicial district of Alaska, with the permanent offices of the district judge and United States marshal. It is connected with Valdez by military telegraph lines, and with other established stations by wireless.

AGRICULTURE.

In the vicinity of Fairbanks and on the southern slope to the north of the town are to be found some of the most flourishing farms in the interior of Alaska. All of the ordinary garden vegetables are most successfully grown; 800 tons of potatoes were produced during the summer of 1914, with a total farm production of 1,642 tons, valued at $151,010.

The farmers are using modern machinery, and as a class they are much more advanced in their methods than similar classes in more favored farming communities. Prices for all produce are comparatively high, but in this connection it must be borne in mind that labor and supplies command a price considered prohibitive elsewhere. There is no reason why the Tanana Valley should not at all times supply the local demand for farm produce, and when transportation is available it can supply mining communities lying in the mountains to the south. (See Appendix G, "Statement of agricultural resources at Fairbanks, prepared by Fairbanks Commercial Club.")

An expert from the Bureau of Soils, Department of Agriculture, states that in the Tanana Valley are to be found considerable areas of the best farming soil to be seen in Alaska, and in the bottoms north to the Yukon River there are 1,500,000 acres of available farming land.

The major portion of the Tanana Valley, near Fairbanks, would have to be drained to be made available for farms.

Throughout the valley there are large areas producing a native hay which, when cut before the first frost, makes a forage of fair quality, on which to winter stock of all kinds. (See Appendix H, "Agricultural lands and agricultural possibilities in certain portions of Alaska.")

The eventual raising of beef cattle in the Tanana Valley may be considered a certainty.

MINERAL DEVELOPMENT.

The mineral resources of the Fairbanks district have been so fully and ably described in various bulletins of the Geological Survey that no detailed mention will be made of them here.

Since the discovery of gold in 1903 the district has produced $63,000,000 in gold, of which the newly established industry of lode mining has produced $900,000. The estimated present yearly output of gold is about $2,500,000.

The bonanza pay streaks of the earlier days have largely been worked out. In a way this is probably beneficial to the camp as a whole as false standards based on extraordinary conditions had been raised. Mining has become more a matter of business than a result of sheer luck, consequently the lower-grade areas are now being mined on more scientific principles than formerly.

With the disappearance of the rich placers the attention of the operator has been turned toward more legitimate forms of mining, and lode mining is rapidly assuming promising proportions. Interesting developments are being made in lode exploration, and undoubtedly this industry is firmly established. Two small mills are operating at a profit notwithstanding the heavy charges of labor, fuel, and supplies. On other lode locations the veins are being opened up and blocked out with the object in view of demonstrating the presence of bodies of ore which will insure the success of a mill when erected.

Dredging has been carried on successfully, and the undoubted large areas of low-grade gravels will be made productive when cheaper fuel or power is available.

At present the average price of wood for fuel purposes on the gold-bearing creeks is $11.25 per cord, a price extremely depressing to placer mining where all the auriferous gravels must be thawed at all seasons of the year.

Flowers grow in great profusion and many of the residences are surrounded by flower gardens which will rival any in the United States proper. While the growing season is short—from the latter part of May to September 1—the long days of midsummer promote rapid growth and the early maturity of all crops.

During the winter there is an excellent stage service on the military road between Fairbanks and Chitina or Valdez, and emergency freight is carried, amounting to 100 tons.

During the summer there is little travel over the military road, although automobile passenger service has recently been established.

Practically all of the freight and most of the passengers are transported to and from Fairbanks by water. The total traffic figures, as obtained from the various transportation companies, are as follows:

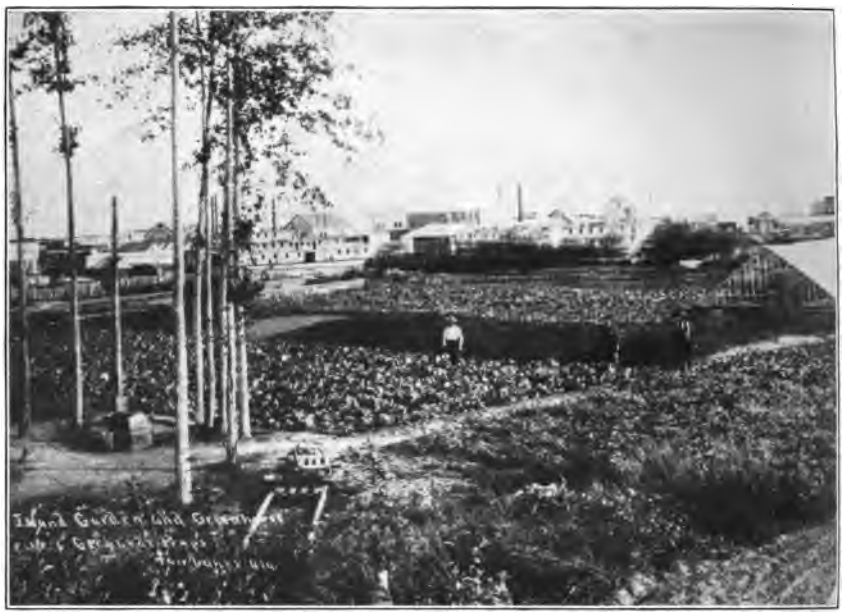
Total freight, inbound	tons	14,167
Total passengers, inbound	number	1,790
Total freight, outbound	tons	291
Total passengers, outbound	number	1,084

RELATION OF FUEL TO DEVELOPMENT.

The fuel used in the Fairbanks mining district is wood, the present annual consumption of which is 95,674 cords, at an average price of $11.25 per cord. (See Appendix I.) Wood suitable for fuel purposes is rapidly disappearing and in the older creeks at times reaches the exorbitant price of $16 per cord, due to the long haul. Throughout the mining district the price is gradually increasing,

PLATE 36.

HAY FIELD NEAR FAIRBANKS.



A. ISLAND GARDEN GREENHOUSE, FAIRBANKS, ALASKA.

B. ESTER CITY SHOWING HILLS DENUDED OF WOOD.

C. RIVER STEAMERS AT FAIRBANKS.

and it is only a question of a short time before all development will be confined to the richer claims, able to stand the great operating expense. Unless cheap fuel or power can be speedily furnished, the production possibilities of a great section of Alaska will become insignificant. Lignite occurs on both of the proposed routes, the best known occurrence being in the Nenana fields, located near the western route at a distance of 107 miles from Fairbanks. Government geologists estimate that the heating properties of this coal are in the ratio of two cords of wood to one ton of coal. With a haul of 107 miles and a ton-mile rate of 1 cent, this coal can be laid down in Fairbanks at a price not to exceed $5 per ton. Fuel supplied at this rate furnishes an immediate tonnage to a railroad of 50,000 tons per year for the Fairbanks district alone. Little is known of the lignite tributary to the eastern route, although its occurrence has been noted by geologists, and prospectors claim to have made discoveries on what would be an extension of the Nenana fields.

With fuel or power furnished to the mine operators at a reasonable cost there is rendered possible the mining of the great areas of the low-grade gold-bearing gravels, the opening of lode mines, and the operation of a number of mills.

From figures furnished the commission by one quartz mill operator, his saving on fuel alone would be $40 per day.

OTHER TRAFFIC TRIBUTARY TO BOTH ROUTES.

Freight and passenger traffic on the lower Tanana River, and a portion of the Yukon, may be considered as tributary to both routes, although a saving to the consumer would be effected, owing to a shorter rail and water haul, were supplies to be delivered where the western route first strikes the Tanana River, near the mouth of the Nenana.

A population of about 1,500 is to be served on the Tanana River and part of the Yukon. Placer activity is reported in the upper Tolovana River, which enters the Tanana 58 miles below Fairbanks. During the past year most favorable reports came from the Hot Springs mining district, where more than 20 claims have produced gold with an output of about $500,000. With the working out of the known fabulously rich pay streaks, creeks long known to contain low-grade placers are now receiving their just recognition, and are being worked on business principles, with returns which may be estimated with reasonable accuracy. As the cost of operation is reduced new areas are being opened up. During the past season about 5,000 tons of freight were delivered to points on the Tanana and Yukon Rivers, which would, in all probability, be transported by a railroad from tidewater to the nearest point on the Tanana River.

HIGH PRICES IN FAIRBANKS AND REASONS THEREFOR.

Under a very varied classification, freight from Puget Sound points, in carload lots, water delivery, to Fairbanks, takes a tariff rate from $55 per ton of 2,000 pounds commodity rates, to $92.75 for class C, with exceptions carrying an additional tariff in places of 180 per cent over base rates, the probable average being $70 per

ton for the general run of merchandise shipments. The first-class passenger rate from Puget Sound points to Fairbanks is $130 northbound, and $135 southbound.

Wholesale prices in Fairbanks in 1914 on some staple articles were as follows:

Bacon	per lb	$0.37½
Lard	do	.20
Hard-wheat flour	per 100 lbs	6.50
Rolled oats	do	8.50
Sugar	do	9.00
Rice	do	11.00
Beans	do	9.00

The above prices, which seem excessive, are not due entirely to high rates of transportation. The wholesale and large retail merchants must place their orders so that shipments for the entire year shall arrive during the open season of navigation. In addition to the freight charges, the following elements enter into their calculations of cost: Interest on investment for whole year; double handling from storage warehouse to store warehouse; warehouse men; heating of warehouse; marine insurance; fire insurance on whole year's stock; overstock which must be replaced by fresh goods during next summer.

In the matter of hams and bacon alone the deterioration is very marked and any overstock is practically worthless, except for dog food.

Given quick transportation at any season of the year, the overhead charges are reduced by a large percentage, overstock is reduced to a minimum, and with the stocks of California, Oregon, and Washington, only one week away, the shelves of the merchants are at all times filled with fresh seasonable goods.

Directly south of the Fairbanks district is the Bonnifield district, lying along the foothills of the Alaskan Range. A certain amount of placer mining is being done in this region. On one of the creeks visited by a member of the commission there were three groups of claims being worked which produced $10 to the shovel per day. The large gravel deposits in this district carry gold and they will undoubtedly be made productive in future development.

CLIMATE.

The average precipitation in the Tanana district is 11.44 inches, including both rain and snow. The average annual temperature is 24° F., with −65° and +88° as the extremes. The average of the three summer months is 57°. The depth of snow rarely exceeds 3 feet at any time during the winter.

TRANSPORTATION.

Fairbanks is served in summer almost entirely by river steamers. The first through steamers down from White Horse usually arrive about the middle of June, and the first steamer up the river, from St. Michael, about July 10. The last steamers leave Fairbanks for either port October 1. All freight for the entire year must be handled during this short season of open navigation. The average amount of inbound freight is 14,000 tons by river service and 790 passengers.

A. LIGNITE EXPOSURE ON NENANA RIVER AND LINE OF PROJECTED RAILROAD.

B. LIGNITE EXPOSURE ON NENANA RIVER AND LINE OF PROJECTED RAILROAD.

C. LIGNITE EXPOSURE ON NENANA RIVER.

A. HEALY CREEK SHOWING COAL VEINS IN SANDSTONE CLIFFS.

B. LIGNITE EXPOSURE ON HOSEANNA CREEK.

WESTERN SYSTEM.

KANTISHNA DISTRICT.

The first resources south of the Tanana Valley, which may be considered as directly tributary to the western route, are in the Kantishna district. Mining has occurred in this region since 1905, and various rushes have occurred, but the rich, shallow pay streaks were found to be limited in area. There are reported to be large areas of low-grade gravels suitable for dredging on the various tributaries. Geologically, the formation is similar to that of the Fairbanks district and should be favorable for the occurrence of mineralized zones. Specimens of ore from this country, plainly showing free gold, have been exhibited to the commission, and information which is considered reliable points to the region as being an ultimate producer of lode gold.

Navigation for small craft is possible on the Kantishna from where it enters the Tanana River (150 miles below Fairbanks) to the foothills, perhaps another 150 miles from the mouth. The most probable route, however, will be by wagon road to a point about mile 390 from Seward. The extreme length of the main road would probably be not more than 70 miles and, according to available information, should be of easy construction and maintenance, following, as it would, the dry, flat gravel benches of the foothills. A spur, tapping this country, might be extended at small relative cost, should future development warrant such a measure.

The present population of the district consists of about 60 miners and trappers. The gold production for 1914, following the most casual methods of mining, was $22,200. Early in the winter the lode properties were the subjects of examination by a number of engineers, whose reports are not yet available. An option was given during the summer on one dredging project, and several other dredging or hydraulicking propositions are now pending. There are possibilities that this district may develop sufficiently to require large import tonnage.

NENANA DISTRICT.

Coal.

At mile 364 from Seward and 107 miles from Fairbanks occur the first of the known coal beds of the Nenana fields. As noted before, the opening of coal fields to furnish an economical and satisfactory fuel for the interior of Alaska is one of the vital needs. The Nenana fields are the best of the known lignite fields and seem to have every requisite for local power and heating demands.

At mile 364 from Seward the croppings appear in large parallel veins in the sandstone cliffs. Should the road follow the east bank of the Nenana River, these mines would be almost directly on the line of railroad. Should the west bank be chosen, a loading station could be reached by a gravity overhead tram at small expense. Large beds occur on Healy Creek, which empties into the Nenana River opposite mile 358. No difficulty will be experienced in constructing a line from mile 358 up the north bank of the Healy to the coal deposits. Directly above the mouth of Healy Creek a most favorable crossing

of the Nenana is found for a branch line, the length of which need not exceed 8 miles.

A preliminary line has been extended up Hoseanna Creek from mile 365 to the coal occurrences on that creek, but the construction will be expensive and difficult of maintenance, owing to the poor supporting ground along the sliding sidehills. For the present, this line need not be considered. For immediate development the coal veins on the trunk line seem to the commission to be the logical ones to receive first attention, should their value as a fuel be demonstrated to be as great as the beds on Healy and Hoseanna Creeks. No analyses are available, but, according to the Division of Mineral Resources of Alaska, United States Geological Survey, as a fuel 1 ton of Nenana lignite should be equal to at least 2 cords of native spruce.

Gold.

During the past year two tributary creeks of Healy Creek were found to contain placer gold, and preparations were under way to open them by ground sluicing. About 15 men were engaged in the preliminary work, and they seemed confident of having developed diggings which would pay a substantial return on their investment of time and labor. On the upper Healy it was noted by one member of the commission, during a reconnoissance of a direct route from the coal fields to Fairbanks, that the creeks flowing through the high gravel benches were most favorable for a narrow concentration of any possible gold. Occasional pannings during the trip showed colors in many localities. There is no record of these creeks ever having been prospected, and lying, as they do, several miles beyond timber line, it is most natural that the prospector would first try his luck where fuel is at hand for camp and mining purposes. Under present conditions, supplies are all brought into the district during the winter by means of dog teams. If freighting is contracted for, the ruling rate is 20 cents per pound from Fairbanks.

BONNIFIELD DISTRICT.

This district is reached by winter trail across the Tanana Valley swamps or up the Tatlanika River by summer pack train. From the western route it could be reached more easily by a road from the mouth of the Hoseanna Creek, up Hoseanna Creek into the headwaters of the Totatlanika River, from which point branch roads or trails could serve the various gold-bearing creeks. For strictly local consumption, coal croppings and well-defined veins were noted on tributaries of the Tatlanika River, and coal is reported near the head of the Totatlanika. Should the Copper River route be selected, these fields may become a source of supply for Fairbanks, although extensive surveys would first have to be conducted to determine a practicable route. The reconnoissance conducted by one member of the commission over one route failed to develop a feasible line.

Soil and climatic conditions are such that all garden vegetables are grown by the miners, and native grass is even now put up for winter forage and successfully used in wintering stock.

A. LIGNITE OUTCROP ON HOSEANNA CREEK.

Note man and rod toward right of picture.

B. COAL EXPOSURE ON TATLANIKA RIVER, NEAR MOUTH OF GRUBSTAKE CREEK.

A. SPRUCE GROVE AND LAUNCH "MIDNIGHT SUN" IN LOWER NENANA RIVER.

B. SPRUCE SUITABLE FOR SMALL TIMBERS ON NENANA RIVER.

BROAD PASS DISTRICT.

What may now be known as the Broad Pass mining district has during the past summer been the subject of much excitement and comment. This district is reached by trail from mile 270 from Seward, thence in a northeasterly direction for 10 or 15 miles, air line. A wagon-road connection would probably start at mile 292, near the summit of Broad Pass.

Lode locations have been staked and prospected for a number of years by men with faith in the country and a belief that eventually a railroad will reach this region. The occurrence of gold-bearing ore is now reported in enormous quantities, but, unfortunately, nothing definitely is known. One sale of property is reported at half a million dollars. Undoubtedly, this section has attracted a great deal of attention, and the prospects were visited by a number of mining engineers during the past year. The ore is said to be comparatively low-grade refractory ore. This being the case, in all probability it would be of great value to a smelting industry established at one of the proposed terminals.

Mr. Alfred H. Brooks, of the Geological Survey, states: "The geology of this field is certainly favorable to the occurrence of metalliferous deposits."

VALDEZ CREEK DISTRICT.

Valdez Creek, a tributary of the headwaters of the Susitna, could be reached by a road from the vicinity of Broad Pass within a distance of about 50 miles. It is also tributary to the Copper River route, by winter road or trail 100 miles from Paxsons on the military road, most of the supplies for present use being transported in winter over this latter road.

The gold placers on Valdez Creek have been worked since 1903 and the district is of proven value, particularly since the installation of a hydraulic plant. Had this plant been installed earlier in the season, the estimated output would have been $100,000.

Nothing is known by the commission of the agricultural resources of the Valdez Creek, although it is supposed that vegetables and sufficient native grass for forage may be grown.

YENTNA DISTRICT.

Placer gold on tributaries of Lake Creek and Kahlitna River, large tributaries of the Yentna River, were discovered in 1905 and have been worked continuously ever since. The main diggings are on Cache and Peters Creeks, where a number of claims are working with satisfactory results. The present trail in winter is up the Yentna from Susitna station on the Susitna River, or by poling boat to McDougall at the mouth of Lake Creek, thence by wagon road and trail to the placer camps. When a railroad is constructed it is thought that a road or trail can be built to the district from the forks of the Chulitna and Susitna Rivers, a distance of about 40 miles. It is quite probable that there are valuable gold lodes all through the district

and along the foot hills of the Mount McKinley range. As has been noted thus far, the various mining and agricultural districts are tributary to a terminal situated at either Seward or Passage Canal. On the short line extending from mile 66 of the Alaska Northern Railroad to Passage Canal there are no known resources furnishing potential tonnage.

SUSITNA, CHULITNA, AND MATANUSKA VALLEYS, COOK INLET REGION, AND KENAI PENINSULA.

Agriculture.

The agricultural lands of the Susitna Valley lie mainly along the western slopes of the hills on the east side of the river. The largest connected area follows the course of the Matanuska River and along the east side of the Knik Arm as far as Turnagain Arm. The area measured from reconnoissances of the Department of Agriculture give this to be 1,300 square miles, exclusive of Kenai Peninsula, which, if all taken up, would result in the establishment of 2,600 farms of 320 acres each. Already about 150 homesteads have been registered at the Knik office.

Vegetables to support a large population may readily be raised, and it is the opinion of the commission that eventually the raising of cattle for beef and dairy products will become an established industry. The native hay, when cut at the proper time, and properly cured, has about the same nutritive value as timothy. The length of the agricultural belt may be roughly placed at 125 miles. (See Appendix H, "Agricultural lands and agricultural possibilities in certain parts of Alaska.")

From reconnoissances made by the Department of Agriculture it is estimated that on the Cook Inlet side of Kenai Peninsula there are approximately 950 square miles of agricultural lands. The valleys of Resurrection and Sixmile Creeks and Placer River furnish a limited amount of bottom land, suitable for small farming. All the usual garden vegetables are grown with great success. Native hay is found in large quantities and government experimentation with the raising of cattle has proven successful. The climate of the Peninsula lends itself more particularly to farming and stock raising than any other part of coastal Alaska.

Coal.

Undoubtedly the most valuable present asset in prospective southbound tonnage is the coal of the Matanuska fields. The beds, from which the sample giving satisfactory results for naval purposes was taken, are situated at Chickaloon, 38 miles from Matanuska Junction, at mile 147 from Seward. There are other beds running from lignite to anthracite in the same region. With the development of these beds will come an immediate tonnage for delivery to the selected terminal. The coal is of known value, both as naval and commercial coal. It has fine coking properties and it is hoped that some day a profitable smelting industry may be built up.

A. HAYING NEAR KENAI LAKE.

B. SPRUCE ON THE TANANA RIVER.

There are large deposits of lignite on the west side of the Kenai Peninsula and also at Tyonek, on the west shore of Cook Inlet. During the summer a coal mine at Port Graham was operated for a purely local demand. It is not probable that this coal will be of any near benefit to a railway, but it is possible that eventually the construction of a branch to the coal fields will be accomplished to serve Seward and mining communities with a cheap fuel.

Gold.

Placer gold is found on both the Chulitna and Susitna Rivers, and their tributaries, but no notable workings have been developed, although there are known instances of relatively small amounts being taken out by miners seeking "grubstakes."

The country is highly mineralized and the geological formation is favorable for lode discoveries.

On Willow Creek, mile 183, three stamp mills are operating with most satisfactory results and other claims are being developed with excellent showings. For 1914 there is a reported output from ore of $300,000. Quartz is also found on tributaries of the Matanuska.

On the north shore of Turnagain Arm there is some placer mining, notably at Indian Bird and Glacier Creeks. On Glacier Creek considerable prospecting on scientific lines was accomplished for the purpose of determining the value of the auriferous gravels for dredging or hydraulicking. Geologically, the formation is favorable for lode discoveries. A certain amount of gold has been discovered in the Nelchina district, but little is known of the value of the camp.

Miners travel either from the Cook Inlet side or from Copper Creek or Tazlina on the eastern route.

The gold product of the Kenai Peninsula for 1914 is estimated at $450,000, and is the result of mining under the most unfavorable conditions. Miners are dependent upon a light motor car, with trailers, run over the Alaska Northern tracks as far as mile 46. Freight is dropped off at various places and transported by boat, wagon, or pack train, according to the facilities available, to the point of operation. No considerable amount of freight can be carried at any one time, and one mine operator was obliged to forego contemplated construction, as the 800 tons of heavy freight offered could not be handled.

At the present time several small stamp mills are operated part of the year, but they are all greatly handicapped by lack of railway transportation and connecting wagon roads. Between Seward and mile 34, of the Alaska Northern, there are from 15 to 20 properties with favorable showing. In the Moose Pass District, which connects by wagon road with the railway at mile 29, there are a number of promising quartz prospects. The various developments and prospects seem to indicate that eventually the Kenai Peninsula will be a heavy producer of gold.

The three principal drainage basins where placer gold is being mined are Resurrection Creek, Sixmile Creek, and Kenai River. On Resurrection Creek two hydraulic plants are in operation and other claims are being prospected, with the possibility of hydraulic min-

ing in view. Sixmile Creek has been thoroughly prospected during the past year, and the commission is informed that dredging plants are assured.

Kenai River, flowing between Kenai Lake and Skilak Lake, shows favorable placer posibilities. The gravels have been drilled and prospected, and the gold contents estimated show good dredging posibilities. On Copper Creek, a tributary of the Kenai River, a hydraulic plant is in operation. Transportation to the Kenai River District is furnished by water from mile 21 at Kenai Lake.

Copper.

Copper occurs near Seward, on the Kenai Peninsula, but little information is available. Valuable deposits and producing mines are found on the islands of Prince William Sound, the ores of which could be transported at small expense to a smelter erected at Seward.

Climate.

The climate of Cook Inlet is the most favorable of any found on the coast of Alaska. The spring season is well advanced over other investigated sections and there is less rain and less heavy wind. The average annual precipitation is 19 inches at Kenai to 35 at Sunrise, on Turnagain Arm. As yet no authentic yearly data is available for upper Knik Arm, but observations at Ship Creek, made during the summer, show the precipitation to be less than at either of the above places. The average yearly temperature is about 36°, with extremes of −46° and +87°. The average of the summer months is 54°. While a temperature of −46° has been recorded at Tyonek, in all justice it must be stated that this is most unusual and that winter temperatures average well above zero.

All evidences tend to show that there is seldom more than 5 feet of snow at any time around the inlet and this rapidly decreases as the ascent is made of the Susitna Valley. At Broad Pass 3 feet may be considered the maximum. Little is known of temperatures in the upper Susitna, but it is presumed that temperatures will run somewhat higher than in the Tanana Valley. The summers would be apt to be somewhat cooler and the winters warmer.

The climate of Kenai Peninsula is extremely favorable for any undertaking, the average annual temperature being 38°, with extremes of −12° and +85°. The average precipitation is 60.50 inches. Snow on the ground is seldom deeper than 4 or 5 feet.

Timber along entire route.

Kenai Peninsula is largely included in the Chugach Forest Reserve. Along the railroad the reserve is entered at about mile 9 and extends to the Knik River. Timber for ties, telephone poles, tempo-

A. GARDEN AT KNIK.

B. TUNNEL IN MATANUSKA FIELDS FROM WHICH MOST OF THE COAL FOR THE NAVAL TEST WAS MINED.

A. SPRUCE ON RILEY CREEK, UPPER NENANA, SUITABLE FOR TIES, POLES, AND SMALL TIMBER.

B. CONCENTRATING CAMP AT KENNICOTT.

rary trestles, and certain classes of lumber are found along the line of the Alaska Northern and along surveyed lines throughout the reserve. Spruce of very good quality is found north of Seward and along Cook Inlet from Kachemak Bay to Turnagain Arm. For railroad construction purposes this would be useful. The islands on the west side of Prince William Sound furnish the best near-by timber to be used in construction.

North of Knik Arm and through the Susitna Valley there are patches of timber which would be available. In the Susitna Valley the very best growth is reported on the west side of the river, along the foothills, and extending well up toward Broad Pass. Areas of timber are found on the upper Nenana, Riley Creek, and Jack River for construction purposes. Below Healy Creek, on the Nenana, there are a number of timbered areas which will furnish a large amount of timber. In the Tanana Valley bridge timbers of the smaller sizes may be cut and practically all of the lumber demands satisfied. Lower Goldstream offers a large amount of tie timber and cordwood tonnage to a railroad until coal mines are under operation. Mining timbers are found on Goldstream and the Tanana.

EASTERN SYSTEM.

RESOURCES ALONG THE EASTERN ROUTE.

The agricultural and mining possibilities around Fairbanks have been mentioned elsewhere and the prospective tonnage given as tributary to either the eastern or western route.

The agricultural possibilities along the eastern route are not great. The country was traversed by representatives of the Bureau of Soils, who report that, aside from the limited areas near Salcha and Richardson, there is not much to be expected along the proposed line of road. In the upper Tanana Valley there are large areas of native redtop and bunch grass, which should furnish summer and winter forage for large herds of cattle. The shipping point for this region would be about 360 miles from Cordova.

On the upper Copper River there are farms which show satisfactory results, but this region is not ranked very high by the Department of Agriculture. It is probable, however, that the farms near the railroad would supply all local demand for many years.

An estimate made by the Cordova Chamber of Commerce places the agricultural and grazing lands at 350,000 acres, but no great claim for agricultural possibilities is made other than for furnishing the supply for local demand.

Gold.

Besides reported dredging possibilities on the Little Chena, Big Chena, and Salcha Rivers there is little in the way of gold development south of the Fairbanks district until the Tenderfoot district is reached, near mile 270 from Cordova. The creeks in this district have been gold-producing since 1905, and the location of a new pay streak has prolonged their life. About 50 men are mining in the vicinity. As mentioned before, the Valdez Creek district is also tributary to the eastern route and successful placer mines are being

operated. From Healy River, a tributary of the Tanana, some 60 or 70 miles above McCarthy, comes a report of finds which may make this territory of producing value. There are placer possibilities on tributaries of the Clear Delta River, which would be reached by trail from mile 300.

The Chisna mining district would be tributary to the railroad at mile 215 or mile 300 by the Chisna trail. This is an old placer district, which has produced probably $2,000,000 in gold and is still producing, particularly on Slate Creek near the mouth of Miller Creek. There are other producing creeks. Placer gold is also reported on the middle fork of the Gulkana River. All of the Alaska Range is geologically favorable for lode discoveries.

The Chisana district, which might be reached by a branch road or wagon road from mile 215, is a producing camp, although the output is not such as warranted the rush in 1913. A large proportion of the supplies now being taken there travel via McCarthy, a station on the Copper River & Northwestern Railway about 101 miles from Cordova, thence by pack train over Scolai Pass and across the headwaters of White Pass. In 1913 the ruling freight rate from McCarthy to the diggings was $1 per pound.

Large low-grade quartz deposits are found on Jack Creek, a tributary of the Nabesna River.

Near Chitina, mile 131, gold quartz is reported. On the eastern route the most successful placer mining district south of Fairbanks is found on tributaries of the Nizina River. Four hydraulic plants are installed, and from one property in particular a large output is reported, although the exact figures are not available. The Nizina district is reached by trail 24 miles from McCarthy. Supplies are usually transported in winter at a cost of $12 to $20 per ton from McCarthy. About $750,000 has been expended on development.

A new placer strike on the Kiagna River, a tributary of the Chitina, is reported and extensive prospecting is in progress.

Placer prospecting with dredging in view is in progress on the Tiekel River, mile 101, and Bremner River, mile 78. Promising gold lodes are near the Tiekel River, and on Canyon Creek, mile 124. Lodes in the McKinley Lake district, not far from Cordova, show favorable prospects.

Coal.

There is only meager information regarding coal near the eastern route available for consumption in the interior.

The Geological Survey reports that workable beds lie on Newman Creek, a tributary of Dry Creek, which might be reached by a road 20 to 35 miles long, extending from Washburn, mile 391. Other beds were noted on Little Delta River, which might be reached by a road 20 miles long, from mile 350. No close examination was made of these beds, but the geologist in charge of the reconnaissance gives as his opinion that workable areas may be found. It is thought that these fields should furnish coal for all the demands of the Fairbanks district.

Coal from Bering River fields may be brought to Cordova by constructing a railroad 38 or 40 miles in length, from the fields to mile 39 of the Copper River & Northwestern Railroad, from which

point it may be diverted either north to the mines or brought to Cordova for export or for conversion into coke for local smelting. With the construction of a line connecting Cordova with the Bering River coal fields the smelting industry will, undoubtedly, follow with Orca Bay as a logical point. In this industry is seen a great future demand for Alaska coal. The combinations of Bering River coke, Copper River ores, and the fluxes of Prince William Sound make smelting at Cordova or Valdez almost a certainty.

A sample of Bering River coal was tested by the Navy Department in 1912, and found to be unsatisfactory for use in the Navy. Geologists, however, familiar with the country express the belief that this test should not condemn the whole field, and probably the veins, if mined from other localities and under different conditions would give a more favorable result. As far as known, the coking qualities of the coal are good.

While coal may be shipped direct to Cordova by rail, still this is not a matter of necessity, and a saving might be effected by constructing a line not to exceed 30 miles in length from the coal fields to Controller Bay. Coal landed at Controller Bay could be barged at small expense to either Cordova or Valdez. A comparison of transportation costs has not been estimated.

Copper.

Undoubtedly the Nabesna district, in which are also the Chisana placer diggings, at some future time will have to be served by a railroad, as the district has copper areas, the value of which can not be disputed.

In the Kotsina-Chitina district there are located the best-known copper deposits in Alaska. Prospects, some of which have attained almost to the dignity of developments, are found on the Kuskolina and Kotsina Rivers and McCarthy Creek. Short branches, the longest of which will not exceed 28 miles in length, will have to be built before these mining districts can be made commercially profitable. The ores are high grade and reported to be in large bodies. The results of surveys made for branch roads are not available, although a number of such have been made.

At Kennicott, the one group of mines, to serve which the railroad was built, show, with a capacity reduced to 50 per cent on account of the low price of the metal, and a curtailed market resultant upon the European war, a shipment of 1,800 tons of copper concentrate each month to the smelter at Tacoma. There are other mines in the process of development which are said to be equal to the Bonanza and Jumbo mines at Kennicott, from which most of the tonnage emanates.

With the present freight rates only the richest mines may ship ore. On account of these high rates the lower grade ores must be neglected unless expensive concentration mills are constructed. For example, ore having a value of $11 per ton, if shipped from the end of the line, will only just pay the freight charges to the smelter at Tacoma. Freight charges are fixed according to ore valuation.

One mine is shipping 1,500 tons of hand-picked ore this winter from McCarthy, after a sled haul of 13 miles. Even with these high initial charges a profit is claimed.

Any system of railroads along the Copper River regions should contemplate the construction immediately of at least three short spurs to camps of known value.

From the best information obtainable there are recorded locations of 581 copper claims, 78 gold quartz claims, and 195 gold placer claims.

Oil.

Wells producing a limited quantity of high-grade oils are found at the head of Katalla Slough, about halfway between Katalla and Controller Bay. From six to eight barrels of oil are pumped from each of several wells daily, and the output distilled at a small plant on the slough. At the present time the company is in financial difficulties and the plant is being operated by a receiver. When visited by members of the commission in September the manager stated that a fair return on and above the cost of operation and maintenance was obtained with a brighter outlook for the ensuing year. A large share of the demands for gasoline and distillate for Prince William Sound and Cook Inlet are satisfied by this plant. The local gasoline was used with good success by the commission on their launches in Cook Inlet. Any railroad to be constructed would aid in the development of this resource.

Other minerals.

The occurrence is noted of lead, silver, and nickel ores, but of these the commission has little direct information.

HARBORS.

Much has been written and said about the various harbors in Alaska and their respective merits as locations for railroad terminals. The report of the Alaska Railroad Commission of 1913 contains abundant information on the subject as do also the reports of the United States Coast and Geodetic Survey. All of the harbors under consideration have been visited by all the members of this commission with the exception of Controller Bay, which was visited by two. The commission has endeavored to present in a condensed form the result of their own observations, together with information received from the previous commission, from the United States Coast and Geodetic Survey and from various commercial bodies and other sources in Alaska. The opinions of various master mariners have been sought, but the results have been rather conflicting and confusing. The commission has drawn no conclusion in favor of any particular harbor. They believe that at any of the harbors considered suitable terminal facilities can be created without excessive cost, and that the question of the most available route for the railroad system to best develop the resources of Alaska is not dependable on the selection of any particular harbor.

No estimate of the cost of creating terminal facilities has been given for the reason that harbor developments are a matter of growth dependent upon the gradual increase of business.

A. OIL WELLS AT KATALLA.

B. PORTAGE BAY FROM THE TRAIL.

VALDEZ FROM ELEVATION OF 2,400 FEET.

The harbors of Cordova, Valdez, Portage Bay, and Seward have certain characteristics in common. They are all deep, all have abundant room, are free from dangers to navigation, and can be entered at any season of the year without danger from ice. Because of the great depth of water, plenty of dockage room would have to be provided. As a rule, they are too deep for mooring buoys to be used to advantage. These harbors are all nearly surrounded by precipitous mountains, through which are deep gaps. While there may be some difference in the amount of wind likely to be encountered in the different harbors, it is not believed there is any great choice in this respect. Any harbor surrounded by mountains in which deep gaps occur is bound to be visited by heavy winds at times. All of these harbors can be easily fortified.

A brief description of the various harbors follows. In giving the tidal range the spring tides are used. In the appendix will be found quotations from the reports of the United States Coast and Geodetic Survey and others.

CONTROLLER BAY.

Distance from Seattle, 1,134 nautical miles. Tidal range, 10 feet.

Controller Bay differs from the other harbors under consideration in that it is not landlocked, but is surrounded by extensive tidal flats. This causes the heavy winds to blow with a constant force rather than take the form of violent willi-waws, as in the harbors surrounded by high mountains. The only entrance to the bay for deep-draft vessels is from the west, and passes between Kanak and Wingham Islands. At the entrance the bar depths are not less than 36 feet at low water. After passing the bar the channel extends a distance of about 3 miles east of Kanak Island. Deep water extends about a mile farther, but the channel narrows rapidly. Okalee Spit and Kayak Island act as breakwaters to the ocean swell. There is plenty of good anchorage anywhere in the channel, where the depths are not too great. It is stated by the United States Coast and Geodetic Survey that there is good anchorage for 75 or 80 ships. The width of the channel can be easily increased by dredging, as the bottom is almost entirely hard gray sand. There are several plans for developing terminal facilities at Controller Bay. One plan is by building about 3 miles across the tidal flats and shoal water separating the channel and the north shore of the bay. Another plan is to build from Strawberry Point across the shallow channel to north end of Kanak Island, thence following the island for a distance, and extending a wharf out to the north arm of Okalee Channel; or, in place of building from Strawberry Point to the island, build from the latter across the mud flats to the mainland east of the mouth of Bering River. To determine the probable cost of either of these plans would require very extensive soundings and study of general conditions.

Controller Bay should not be confused with Katalla Bay, which is a few miles north and which is simply an indentation in the unprotected coast open to the ocean swell.

Extract from the report of Capt. Paul C. Whitney, of the United States Coast and Geodetic Survey, regarding Controller Bay is found in the appendix.

CORDOVA.

Distance from Seattle, 1,220 nautical miles. Tidal range, 12.9 feet. Average rainfall, 128.5 inches. Snowfall, 182 inches.

Cordova, the coast terminus of the Copper River & Northwestern Railway, is located on Orca Inlet, an indentation of the east shore of Prince William Sound. The population in the census of 1910 is given as 1,152. The town is well supplied with modern improvements, such as hotels, streets, bank, and water and electric-light systems. It is built mostly on the foothill slopes on the coast side of the southern end of Orca Inlet. There is not much room for expansion except by filling in the tidal flats in front of the town, thus providing ample room for industrial development. The lower end of Eyak Lake, a considerable body of water east of the town, could be filled in and would add much to the available space.

At Cordova are situated the shops of the Copper River & Northwestern Railway. The railway company has a substantial wharf of 80 by 700 feet, located about a mile north of the town. On this wharf there are several spur tracks and ample facilities for hauling the traffic of the road. The track between the town and the wharf follows along the bluff shore with light rock cuts and occasional trestles.

The harbor of Cordova is completely landlocked and is considered safe in all weather. While strong northeast winds occasionally blow from the openings in the mountains, ships anchored close to the shore are well protected from them. It is estimated that there are about 4 square miles of anchorage area for large vessels in close proximity to Cordova. The entrance to the harbor is made from the north, through the narrows between Channel Island and Salino Point, thence around North Island about 5½ miles north of Cordova. There is also a cut-off channel which can be used by vessels of about 2,500 tons, between Salino and Knob Points of Hawkins Island and North and Observation Islands. This latter channel is narrow and has only 3 or 4 fathoms of depth at low water at its eastern outlet, but could probably be improved by dredging. There is no entrance directly from Prince William Sound east of Hawkins Island, the water being too shallow.

There are several sites that could be made available for coaling stations. The one which would necessitate the least outlay is in the bight just south of the railroad wharf. Here about 20 acres could be filled in and made available. Several sites are proposed on Hawkins Island, but these would involve a bridge 1¾ miles in length across Orca Inlet in order to provide railroad service. Another site proposed is at Sheppards Point, near Nelson town site, at the head of Orca Bay, where a large amount of level land is available, but which can only be reached by railroad by building along the bluffs for 10 miles at a very heavy expense.

VALDEZ.

Distance from Seattle, 1,235 nautical miles. Tidal range, 12.5 feet. Average rainfall, 49.68 inches. Snowfall, 375 inches.

Valdez, a town of about 1,500 inhabitants, census 1910, situated near the head of Port Valdez, is the most northerly ice-free port in

Alaska. Located as it is in the delta of the Valdez Glacier, the town has annually been subject to rather disastrous floods from the streams running from the glacier, which are continually changing their channels. It is thought that the danger from this source has been obviated by the construction in 1913 of a strong dike surrounding the town, and which so far has been found to fulfill its purpose.

Immediately west of the town are extensive flats, large portions of which could be easily filled and utilized for terminal purposes. On the north shore of the bay, about 3 miles west of the town, near Mineral Creek, is a quite large flat sufficient for the development of a town of considerable size. This would be quite easily reached by a railroad. The winds of Valdez are said to be rather severe at times, but as we move westward the country is more protected.

Valdez is an up-to-date, modern town, having large stores, banks, a good water supply, and electric-lighting plant. It is the headquarters of the third judicial district of Alaska and is the starting point of the military road and telegraph line to Fairbanks and the interior. The town has two long wharves which extend across the mud flats to deep water. The direction of these wharves is such that vessels have to lie broadside to the prevailing winds. By dredging channels alongside this condition would be obviated. (See appendix.) One wharf is owned by the town and the other by local interests. Valdez has been the scene of several railroad enterprises, none of which has developed very extensively. The harbor of Valdez is about 2 miles in length and from 2 to 3 miles wide. It is approached from Prince William Sound, through the Valdez Narrows. In the middle of the narrows is a reef which, now being marked by a beacon, is no longer a menace to navigation. Owing to the depth of the bay, good anchorage is scarce, but this can be remedied by the construction of suitable docks and dolphins. Across the bay from Valdez is the military reservation of Fort Liscum. Adjacent to this in the west is a small cove affording some anchorage, and a projecting point affords considerable protection from the wind. Local seas are not considered of sufficient size at any period to be considered dangerous. Valdez Harbor is surrounded by precipitous mountains and could be easily fortified.

PASSAGE CANAL (PORTAGE BAY).

Distance from Seattle, 1,240 nautical miles. Tidal range, 9.6 feet. Annual rainfall and snowfall not known.

Passage Canal, or Portage Bay as it is sometimes called, is a narrow fiord, 8 miles in length and from 1 to 2 miles in width, which extends westerly from Port Wells, on the west side of Prince William Sound. The bay is mostly surrounded by high and precipitous mountains, which, with a few exceptions, rise abruptly from the water's edge. The waters are deep, ranging from 40 to 200 fathoms, and free from dangers to navigation. Anchorage is somewhat limited. The United States Coast and Geodetic Survey notes there is good anchorage with swinging room for one vessel up to 200 feet in length, maximum draft, in Entry Cove, just under Point Pigot, in about 13 fathoms, soft bottom. Fair anchorage, with swinging room for one vessel up to 325 feet, maximum draft, in 12 to 14 fathoms, gravel bot-

tom, at the head of Passage Bay. Good anchorage, in 10 to 20 fathoms, sticky bottom, with swinging room for two maximum size vessels and one up to 350 feet in length and 25 feet draft may be found on the shoal area on the south side of Passage Canal, about 3 miles from its head. The lack of anchorage would have to be supplied by the construction of docks. From the best evidence obtainable it would seem that there would be no danger from ice in Passage Canal. The wind conditions are apparently not bad. (See report of Capt. Rude.) The southeasters seem to be greatly reduced in violence by the time they reach the bay. The westerly, or glacier winds, coming over the Taku Pass usually bring clear weather. While these winds are sometimes quite strong, the short sweep across the bay does not allow the creating of bad seas.

The commission has stationed a weather observer at Passage Canal for the winter, so it is hoped to obtain more extended data regarding conditions there. During the past season parties working in this vicinity experienced a large amount of wet weather, but this seems to have been universal along the Alaska coast.

The available localities for railroad terminals and town-site purposes consist of two gravel flats, one situated at the head of the bay at the mouth of the Taku Pass, the other about a mile easterly on the south side of the bay. The former contains about 145 available acres and the latter 151. Between the two are some available points for coal-bunker sites or some can be found east of the second flat. The easterly flat would be the initial point from which to start a railroad, as its distance from the entrance to the tunnel that will be required at the head of the bay allows of quite a rise in grade.

The course followed by the survey in leaving Passage Canal is fully outlined in another portion of this report.

At the head of Passage Canal and separating it from the drainage of Turnagain Arm is the Taku Pass. In this pass lies the Portage Glacier, one small lobe of which extends toward the bay. Any progress of this portion would be shut off by a narrow rock canyon. A considerable stream starting from the glacier passes in various channels across the flat below, but can be confined to one channel without much difficulty.

A small glacier, known as Longfellow Glacier, overhangs the northern edge of the flat, and the Whittier Glacier flows into the upper edge of the easterly flat, but no trouble is anticipated from these glaciers. Overhanging the upper edge of the easterly flat is the Whittier Glacier.

SEWARD.

Distance from Seattle, 1,235 nautical miles. Tidal range, 10.9 feet. Average rainfall, 60.50 inches; snowfall, 65.4 inches.

Seward is situated on the Kenai Peninsula, near the head of Ressurrection Bay. It is a flourishing town containing several hotels, good stores, a bank, and other attributes of civilization. The population, by the census of 1910, is given as 534. This varies in accordance with the amount of mining in progress on the Kenai Peninsula and the tributary country. The town has a good water supply and electric-lighting system, both of which are easily capable of expansion. The town is well located on an easy slope backed by high hills. To the north are extensive flats allowing for a liberal expan-

THE WHARF AT SEWARD.

SHIP CREEK HARBOR.

sion in that direction. At Lowell Point, a large flat about 1½ miles south of the town, on the west side of the bay, the United States Government has reserved a large area for naval purposes. The Alaska Northern Railroad has its terminus at Seward. To extend the road to Lowell Point would require considerable excavation on the steep, rocky slopes separating the town from this flat.

Resurrection Bay, which extends in a north and south direction, is about 16 miles in length, and from 3 to 5 miles in width. It is mostly surrounded by high precipitous mountains, which, excepting at the flats above noted and another quite extensive one on the east side of the bay opposite the town, extend to the water's edge. The entrance to the bay is easy and free from dangers to navigation. The waters of the bay are very deep, ranging from 60 to 150 fathoms, rendering good anchorage scarce. This would have to be overcome by the erection of wharves and the placing of mooring buoys and dolphins. The prevailing winds are the land winds from the north, and the southeast winds, both of which are strong at times. The present wharf at Seward (owned by the railroad company) is badly located, it being at the south end of the town and placed normal to the direction of the southeast winds. These winds being very strong at times, vessels have great difficulty in lying there. The wharf could be easily moved either to the easterly front of the town or to some point between the town and Lowell Point, in either of which localities it could be so placed in a north and south direction that vessels would lie bow or stern on to the wind, or channels could be dredged in the flats at the head of the bay and wharves erected thereon.

Thumb Cove, about 8 miles from Seward offers a small amount of anchorage, as does also Sunny Cove on Renard Island, about 14 miles south of the town.

There are several localities available for the construction of coaling stations, one along the east front of the town and one between the town and Point Lowell.

SHIP CREEK.

Distance from Seattle, 1,430 nautical miles. Tidal range, 37.2 feet. Average rainfall and snowfall not known.

As stated elsewhere, Ship Creek town site is on the easterly shore of Knik Arm, and is practically at the head of navigation for ocean-going steamers. It derives its name from a stream coming from the eastward. It is the nearest point on tidewater from which the products of the Matanuska coal fields can be shipped on colliers or vessels of large size, the distance from the coal fields being 74.9 miles. This is 58 miles less than to Passage Canal and 120 miles less than to Seward. The maximum grade against the coal traffic is 0.4 per cent, being the same as to Passage Canal, but as against 2.2 per cent to Seward. The direct distance from Seattle to Ship Creek is given by the United States Coast and Geodetic Survey as 1,430 nautical miles, as against 1,240 miles to Passage Canal and 1,235 miles to Seward. Both lines of steamers plying between Puget Sound and Alaska ports have made this a port of call during the past season.

The vessels lie in the channel about a mile offshore and transfer freight to launches or barges, which is later landed at a favorable stage of the tide.

For purposes of landing a limited amount of construction equipment and material the present methods could be used, but for extensive shipments greater facilities should be provided. This can be easily done by dredging an interior basin and approach channel, the former to be deep enough to float vessels at low tide, at an expense little, if any, above the cost of proper terminals at the other suggested ports. The tidal range at Ship Creek is large, but the same may be said of Liverpool, Hull, and other great shipping points. The United States Government has withdrawn from entry for town-site purposes a tract of land containing about 7 square miles. Many acres of this are level or on easy slopes, giving room for extensive terminal facilities. In Ship Creek is an unlimited amount of fresh water. This can be easily turned into any dredged basin, and will serve as a protection for piling in wharves against the ravages of the teredo and other marine borers. The climate is superior to any port on the southern coast. The United States Coast and Geodetic Survey is quoted as saying that "Ship Creek possesses the advantage of unlimited anchorage room except in so far as its waters may be obstructed by ice during a portion of the year." Large ships should have no difficulty in reaching Ship Creek without appreciable delay. Naval vessels might hesitate to navigate some of the channels near Fire Island at extreme low water, but with the large tidal range a wait of a few hours would take them over the bars without the slightest danger.

The objection brought against Ship Creek as a shipping point is that the harbor is not open for the whole year; that there is a period of four or five months when ice conditions render it unsafe for vessels to enter. The evidence on this point is rather conflicting, some witnesses claiming that there are periods during every month in the year when the harbor can be entered with safety. The commission has placed an observer at Ship Creek to make careful note of ice conditions this winter and hope next spring to have more definite knowledge on the subject. Even the most pessimistic acknowledge that for seven or eight months the shipping conditions would be favorable.

ESTIMATES OF COST.

The estimates of cost have been prepared on information obtained by field surveys. Computations have been made on the following basis:

Excavation.—Width of roadbed, 20 feet. Side slopes, according to the nature of the material.

Embankment.—Width of roadbed, 18 feet. Side slopes, 1½ to 1.

Bridges.—Cooper's E–50 loading has been used in figuring all bridges.

Weight of rail.—Seventy-pound A. S. C. E. section, O. H. rail was used in figuring cost of track.

A recapitulation of these estimates is given below. Details will be found in Appendix Z.

ESTIMATE No. 1.—*Portage Bay to Fairbanks via Susitna Valley and branch lines.*

Recapitulation:	
1. Terminal docks and yards at Portage Bay (approximately)	$150,000
2. Construction of line, Portage Bay to Fairbanks	25,517,866
3. Ship Creek branch	123,635
4. Ship Creek terminals	25,000
5. Matanuska coal branch	1,766,684
Grand total	27,583,185

ESTIMATE No. 2.—*Seward to Fairbanks via Susitna Valley and branch lines.*

Recapitulation:	
1. Terminal docks and yards at Seward	$150,000
2. Estimated cost of repairing Alaska Northern R. R. (see Appendix D)	955,601
3. New construction, Kern Creek to Fairbanks [1]	22,621,798
4. Ship Creek branch [1]	123,635
5. Ship Creek terminals	25,000
6. Matanuska coal branch [1]	1,766,684
Grand total	[2] 25,642,718

ESTIMATE No. 3.—*Ship Creek to Chickaloon-Matanuska coal fields (74.9 miles).*

Recapitulation: Ship Creek to Chickaloon, 74.9 miles ..... [3] $3,452,810

ESTIMATE No. 4.—*Chitina to Fairbanks (313 miles).*

Recapitulation: Chitina to Fairbanks, 313 miles new construction $13,803,946

ESTIMATE No. 5.—*Mile 39, Copper River & Northwestern R. R. to Lake Charlotte (25.36 miles).*

Recapitulation: Mile 39, Copper River & Northwestern R. R. to Lake Charlotte, 25.36 miles $1,023,440

ESTIMATE No. 6.—*Chitina to Matanuska coal fields.*

Recapitulation:	
1. Chitina to Copper Center, 50 miles	$2,400,325
2. Copper Center to Chickaloon, 113 miles	4,520,061
Total	6,920,386

ESTIMATE No. 7.—*For constructing line north bank of Tanana River.*

Chena to Nenana, 50.49 miles $2,457,441

Estimates do not include rolling stock.

CONCLUSION.

In presenting this report the commission has not deemed it necessary or proper to make any recommendations as to the best route to follow. This commission is essentially an engineering one, organized to handle the subject along technical lines. In selecting a route other questions besides strictly engineering ones are to be considered. The commission has understood that their especial mission was to collect the evidence and present it in as impartial a form as possible, knowing it would be weighed carefully and acted upon wisely. As stated earlier in this report, the commission had at its disposal much in-

[1] Details under estimate No. 1.
[2] Does not include cost of Alaska Northern R. R.
[3] Does not include terminals at Ship Creek, the cost of which would vary according to the extent of its use as a shipping point.

formation regarding various routes. There was also much that was lacking. This we have endeavored to supply by actual surveys and estimates and also by going over data compiled by other parties and modifying the same as seemed advisable. So much has been written and said about the vast resources of Alaska that we have not deemed it necessary to add much thereto, but simply to call attention to the salient facts and add a brief résumé of recent developments. That Alaska is wonderfully rich in minerals has already been proven. That its agricultural resources are at least sufficient to sustain a large population can easily be demonstrated to those willing to listen. There is practically no limit to its coal supply.

The initial need of the Territory is reasonable transportation. With that, a rapid development is probable; without it, the growth will be exceedingly slow. It is hard to show the great importance of this excepting to those familiar with frontier conditions. As a striking example, we have but to look at the great gold mines near Juneau. Here, having water transportation close at hand, very low-grade ores can be worked at a good profit. Ores of four or five times the value could not be worked in the interior of Alaska, owing to the great cost of transportation. This is but one of many examples that could be cited. That the high rates of transportation are a leading factor in the high cost of foodstuffs and general supplies is self-evident. That there may be a few lean years for a pioneer railroad while the country is building up is possible, in fact quite probable, but that it will eventually be a success can not be doubted. Take the history of many of our western railroads for example; they started through a country in many instances much less promising than Alaska, and now who would dare question their success? As an indispensable adjunct to a system of railroads, there should be a system of wagon roads. Trunk lines need feeders, and where it is often expensive to build branch railroads good wagon roads are an excellent substitute. The Alaska Road Commission has done much excellent work in the Territory, but their means have been limited. It is to be hoped that they may have much more encouragement in the future.

As stated elsewhere, the selection of any particular harbor, or, we may add, the existence of any present center of population, is not a vital element in the selection of a route for the development of the Territory. These should undoubtedly be carefully considered, but it must be remembered that we are building not simply for the present population of Alaska but for the far greater population that is to come.

In conclusion the commission wishes to acknowledge its obligations to the Board of the Alaska Road Commissioners, Division of Mineral Resources of the United States Geological Survey, Bureau of Mines, Forestry Service, Bureau of Soils, and Coast and Geodetic Survey for valuable information furnished and assistance rendered; also to express its appreciation of the friendly cooperation of the various commercial organizations and others in Alaska in obtaining statistics as to resources and other matters.

Respectfully submitted.

WM. C. EDES, *Chairman.*
F. MEARS, *Member.*
THOMAS RIGGS, JR., *Member.*

APPENDIXES.

Appendix A.—COPY OF ACT OF CONGRESS, APPROVED MARCH 12, 1914, TO AUTHORIZE THE PRESIDENT TO CONSTRUCT RAILROADS IN THE TERRITORY OF ALASKA.

[PUBLIC—No. 69—63D CONGRESS.]

[S. 48.]

AN ACT To authorize the President of the United States to locate, construct, and operate railroads in the Territory of Alaska, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States is hereby empowered, authorized, and directed to adopt and use a name by which to designate the railroad or railroads and properties to be located, owned, acquired, or operated under the authority of this act; to employ such officers, agents, or agencies, in his discretion, as may be necessary to enable him to carry out the purposes of this act; to authorize and require such officers, agents, or agencies to perform any or all of the duties imposed upon him by the terms of this act; to detail and require any officer or officers in the Engineer Corps in the Army or Navy to perform service under this act; to fix the compensation of all officers, agents, or employees appointed or designated by him; to designate and cause to be located a route or routes for a line or lines of railroad in the Territory of Alaska not to exceed in the aggregate one thousand miles, to be so located as to connect one or more of the open Pacific Ocean harbors on the southern coast of Alaska with the navigable waters in the interior of Alaska, and with a coal field or fields so as best to aid in the development of the agricultural and mineral or other resources of Alaska, and the settlement of the public lands therein, and so as to provide transportation of coal for the Army and Navy, transportation of troops, arms, munitions of war, the mails, and for other governmental and public uses, and for the transportation of passengers and property; to construct and build a railroad or railroads along such route or routes as he may so designate and locate, with the necessary branch lines, feeders, sidings, switches, and spurs; to purchase or otherwise acquire all real and personal property necessary to carry out the purposes of this act; to exercise the power of eminent domain in acquiring property for such use, which use is hereby declared to be a public use, by condemnation in the courts of Alaska in accordance with the laws now or hereafter in force there; to acquire rights of way, terminal grounds, and all other rights; to purchase or otherwise acquire all necessary equipment for the construction and operation of such railroad or railroads; to build or otherwise acquire docks, wharves, terminal facilities, and all structures needed for the equipment and operation of such railroad or railroads; to fix, change, or modify rates for the transportation of passengers and property, which rates shall be equal and uniform, but no free transportation or passes shall be permitted except that the provisions of the interstate commerce laws relating to the transportation of employees and their families shall be in force as to the lines constructed under this act; to receive compensation for the transportation of passengers and property, and to perform generally all the usual duties of a common carrier by railroad; to make and establish rules and regulations for the control and operation of said railroad or railroads; in his discretion, to lease the said railroad or railroads, or any portion thereof, including telegraph and telephone lines, after completion under such terms as he may deem proper, but no lease shall be for a longer period than twenty years, or in the event of failure to lease, to operate

the same until the further action of Congress: *Provided*, That if said railroad or railroads, including telegraph and telephone lines, are leased under the authority herein given, then and in that event they shall be operated under the jurisdiction and control of the provisions of the interstate commerce laws; to purchase, condemn, or otherwise acquire upon such terms as he may deem proper any other line or lines of railroad in Alaska which may be necessary to complete the construction of the line or lines of railroad designated or located by him: *Provided*, That the price to be paid in case of purchase shall in no case exceed the actual physical value of the railroad; to make contracts or agreements with any railroad or steamship company or vessel owner for joint transportation of passengers or property over the road or roads herein povided for, and such railroad or steamship line or by such vessel, and to make such other contracts as may be necessary to carry out any of the purposes of this act; to utilize in carrying on the work herein provided for any and all machinery, equipment, instruments, material, and other property of any sort whatsoever used or acquired in connection with the construction of the Panama Canal, so far and as rapidly as the same is no longer needed at Panama, and the Isthmian Canal Commission is hereby authorized to deliver said property to such officers or persons as the President may designate, and to take credit therefor at such percentage of its original cost as the President may approve, but this amount shall not be charged against the fund provided for in this act.

The authority herein granted shall include the power to construct, maintain, and operate telegraph and telephone lines so far as they may be necessary or convenient in the construction and operation of the railroad or railroads as herein authorized and they shall perform generally all the usual duties of telegraph and telephone lines for hire.

That it is the intent and purpose of Congress through this act to authorize and empower the President of the United States, and he is hereby fully authorized and empowered, through such officers, agents, or agencies as he may appoint or employ, to do all necessary acts and things in addition to those specially authorized in this act to enable him to accomplish the purposes and objects of this act.

The President is hereby authorized to withdraw, locate, and dispose of, under such rules and regulations as he may prescribe, such area or areas of the public domain along the line or lines of such proposed railroad or railroads for townsite purposes as he may from time to time designate.

Terminal and station grounds and rights of way through the lands of the United States in the Territory of Alaska are hereby granted for the construction of railroads, telegraph and telephone lines authorized by this act, and in all patents for lands hereafter taken up, entered or located in the Territory of Alaska there shall be expressed that there is reserved to the United States a right of way for the construction of railroads, telegraph and telephone lines to the extent of one hundred feet on either side of the center line of any such road and twenty-five feet on either side of the center line of any such telegraph or telephone lines, and the President may, in such manner as he deems advisable, make reservation of such lands as are or may be useful for furnishing materials for construction and for stations, terminals, docks, and for such other purposes in connection with the construction and operation of such railroad lines as he may deem necessary and desirable.

SEC. 2. That the cost of the work authorized by this act shall not exceed $35,000,000, and in executing the authority granted by this act the President shall not expend nor obligate the United States to expend more than the said sum; and there is hereby appropriated, out of any money in the Treasury not otherwise appropriated, the sum of $1,000,000 to be used for carrying out the provisions of this act, to continue available until expended.

SEC. 3. That all moneys derived from the lease, sale, or disposal of any of the public lands, including townsites, in Alaska, or the coal or mineral therein contained, or the timber thereon, and the earnings of said railroad or railroads, together with the earnings of the telegraph and telephone lines constructed under this act, above maintenance charges and operating expenses, shall be paid into the Treasury of the United States as other miscellaneous receipts are paid, and a separate account thereof shall be kept and annually reported to Congress.

SEC. 4. That the officers, agents, or agencies placed in charge of the work by the President shall make to the President annually, and at such other periods as may be required by the President or by either House of Congress, full and complete reports of all their acts and doings and of all moneys received and

expended in the construction of said work and in the operation of said work or works and in the performance of their duties in connection therewith. The annual reports herein provided for shall be by the President transmitted to Congress.

Approved, March 12, 1914.

Appendix B.—STATEMENT SHOWING EARNINGS AND OPERATING EXPENSES, COPPER RIVER & NORTHWESTERN RAILWAY.

Earnings and operating expenses from Nov. 1, 1911, to June 30, 1914.

RECAPITULATION.

	Eight months ended June 30, 1912.	Year ended June 30, 1913.	Year ended June 30, 1914.
Gross revenue	$466,271.38	$433,560.41	$685,452.30
Operating expenses	301,383.43	575,059.85	586,078.46
Net revenue or net deficit	164,887.95	— 141,499.44	99,373.84
Licenses and wharf taxes	15,326.44	22,266.40	22,625.55
Actual net revenue or deficit	149,561.51	—[1] 163,765.84	76,748.29

[1] Deficit.

Actual net revenue, 3 periods	$62,543.96
Average annual revenue	23,454.00

NOTE.—The above figures do not include interest charges on capital invested.

REVENUE FROM OPERATION.

	Eight months ended June 30, 1912.	Year ended June 30, 1913.	Year ended June 30, 1914.
Freight revenue	$396,577.03	$369,384.96	$528,393.85
Passenger revenue	33,247.40	36,806.43	89,080.50
Mail revenue	13,063.56	2,295.02	28,646.81
Wharf revenue	15,726.37	16,363.93	26,461.22
Express revenue	733.18	1,388.91	1,650.50
Telephone revenue	1,590.70	2,875.33	4,903.08
Excess baggage revenue	169.15	110.65	724.45
Switching revenue	505.81	550.51	558.63
Miscellaneous revenue	1,233.05	2,952.55	4,043.45
Construction freight	3,425.13	832.12	489.81
Total	466,271.38	433,560.41	685,452.30

OPERATING EXPENSES.

	Eight months ended June 30, 1912.	Year ended June 30, 1913.	Year ended June 30, 1914.
MAINTENANCE OF WAY AND STRUCTURES			
1. Repairs to roadway and track	$124,712.05	$253,815.40	$234,823.74
2. Renewal of rails	96.89	880.64	.....
3. Renewal of ties	533.29	2,227.89	2,006.69
4. Renewal and repair of bridges and culverts	18,378.32	73,801.95	53,366.79
5. Renewal and repair of fences and crossings	55.86	619.60	315.54
6. Renewal and repair of buildings and fixtures	3,500.10	4,438.07	14,302.62
7. Renewal and repair of docks and wharves	349.12	2,657.37	1,335.96
8. Renewal and repair of telephones	1,607.48	4,123.08	5,029.38
9. Stationery and printing	27.55	5.50	35.00
10. Other expenses	7,272.75	11,595.94	42,417.97
	156,533.41	354,155.44	353,633.69

Earnings and operating expenses from Nov. 1, 1911, to June 30, 1914—Contd.

OPERATING EXPENSES—Continued.

	Eight months ended June 30, 1912.	Year ended June 30, 1913.	Year ended June 30, 1914.
MAINTENANCE OF EQUIPMENT.			
11. Superintendence	$5,595.00	$7,504.55	$6,921.30
12. Repairs to locomotives	21,480.35	37,120.57	22,589.13
12a. Depreciation of locomotives		5,984.04	5,984.04
13. Repairs to passenger train cars	672.87	931.37	4,077.08
13a. Depreciation of passenger-train cars		1,645.44	1,645.44
14. Repairs to freight cars	2,733.59	9,527.42	13,364.94
14a. Depreciation of freight cars		5,055.60	5,055.60
15. Repairs to work equipment	7,732.02	25,856.07	15,408.87
15a. Depreciation of work equipment		11,195.16	11,195.16
17. Repairs to shop machinery and tools	3,350.02	5,435.22	8,242.35
18. Stationery and printing		40.83	79.37
19. Other expenses	844.81	[1] 112.86	628.25
	42,408.66	110,184.01	96,191.53
TRAFFIC EXPENSES.			
20. Salaries	2,448.06	3,009.48	1,556.00
21. Advertising	3,006.64	1,319.90	1,774.78
	5,454.70	4,329.38	3,330.78
CONDUCTING TRANSPORTATION.			
22. Superintendence	[1] 4,615.83	6,943.93	7,498.55
23. Station service	[1] 7,452.48	10,159.75	11,791.18
24. Yard enginemen		1,631.85	2,291.10
23*. Engine and roundhouse men	2,255.62		
25. Other yard employees	1,064.21	1,270.56	2,286.78
26. Fuel for yard locomotives		1,862.64	1,734.60
24*. Fuel for locomotives	[1] 23,368.21		
27. Other yard expenses		1,190.91	1,816.41
28. Road enginemen (see also 23*)		5,646.20	7,210.35
29. Fuel for road locomotives		11,815.97	21,265.75
25*. Water supply for locomotives	2,424.19		
26. Oil, tallow, and waste for locomotives	[1] 623.46		
30. Other locomotive supplies	[1] 413.47	6,542.71	8,016.67
31. Road trainmen	[1] 12,755.37	7,505.05	9,389.56
32. Train supplies and expenses	[1] 6,917.68	3,776.32	14,366.72
31*. Telegraph expenses	[1] 1,464.45		
34. Loss and damage, freight	[1] 28.03	458.68	1,500.72
35. Injuries to persons	[1] 198.00		1,388.30
36. Other casualties		276.31	839.07
36*. Clearing wrecks	[1] 498.53		
39*. Stationery and printing	[1] 423.81		
37. All other expenses	[1] 880.37	825.30	378.03
	[1] 65,383.71	59,906.18	91,776.79
GENERAL EXPENSES.			
41. Salaries of general officers	10,921.07	14,292.29	14,319.40
42. Salaries of clerks	3,817.57	5,872.22	5,871.50
43. General office supplies and expenses	203.97	3,327.02	2,535.04
44. Insurance	3,899.86	7,351.72	3,478.45
45. Law expenses	6,168.75	12,496.43	12,500.23
46. Stationery and printing	485.99	575.91	565.92
47. Other expenses	6,105.74	2,569.25	2,875.13
	31,602.95	46,484.84	42,145.67
Gross earnings	466,271.38	433,560.41	685,452.30
Operating expenses	301,383.43	575,059.85	586,078.46
Net revenue or deficit	164,887.95	[2] 141,499.44	99,373.84
Less licenses	13,016.64	19,525.00	19,525.00
Less wharf taxes	2,309.80	2,741.40	3,100.55
Actual net revenue or deficit	149,561.51	[2] 163,765.84	76,748.29

[1] From an early classification.

[2] Deficit.

Appendix C.—STATEMENT SHOWING FREIGHT TONNAGE TRANSFERRED OVER COPPER RIVER & NORTHWESTERN RAILWAY.

Tonnage statement—Revenue freight Jan. 1, 1912, to Sept. 30, 1914.

	Northbound.		Southbound.		Total.
	Kennicott.	Other.	Kennicott.	Other.	
1912.					
January	157	461	1,875	3	2,496
February	271	358	2,383	5	3,017
March	640	1,423	1,855	2	3,920
April	266	571	1,258	6	2,101
May	148	228	1,638	1	2,015
June	200	231	1,726	68	2,225
July	630	578	1,603	158	2,969
August	445	137	1,589	16	2,187
September	409	156	296	59	920
October	300	224	393	2	919
November	515	505	2,712	31	3,763
December	379	390	1,832	3	2,604
Total for year	4,360	5,262	19,160	354	29,136
1913.					
January					
February					
March	1,134	1,191	374	7	2,706
April	565	415	378	6	1,364
May	19	98	466	9	592
June	207	174	1,789	28	2,288
July	230	156	1,342	129	1,857
August	628	532	1,583	122	2,865
September	276	432	1,054	6	1,768
October	514	634	1,899	38	3,085
November	786	376	1,826	27	3,017
December	882	642	1,558	5	3,087
Total for year	5,331	4,652	12,269	377	22,629
1914.					
January	311	999	845	1	2,156
February	388	445	411	282	1,526
March	522	636	89	326	1,573
April	652	416		113	1,181
May	434	273	314	11	1,032
June	437	369	2,239	111	3,156
July	521	157	1,651	82	2,411
August	387	180	1,232	48	1,847
September	501	275	1,227	68	2,071
Total for 9 months	4,153	3,750	8,008	1,042	16,953

RECAPITULATION.

	Northbound.		Southbound.		Total.	Total ton-miles.
	Kennicott.	Other.	Kennicott.	Other.		
1912	4,360	5,262	19,160	354	29,136	3,575,808
1913	5,331	4,652	12,269	377	22,629	3,600,018
1914 (9 months)	4,153	3,750	8,008	1,042	16,953	2,999,147
Total tons	13,844	13,664	39,437	1,773	68,718	10,174,973

Appendix D.—STATEMENT SHOWING APPROXIMATE COST OF PUTTING THE ALASKA NORTHERN RAILWAY IN CONDITION FOR LIGHT TRAFFIC.

Estimates of approximate cost of placing Alaska Northern Railway in condition for traffic.

14 tunnel portals, at $345	$4,830
3,030 linear feet tunnel lining, at $28	84,840
41,971 linear feet bridges, at $6	251,826
88,260 cubic yards fill, at $0.40	35,304
8,050 cubic yards earth excavation, at $0.50	4,025
31,620 cubic yards loose-rock excavation, at $0.75	23,715
10,510 cubic yards solid-rock excavation, at $1.50	15,765
51,230 cubic yards riprap, at $1.50	76,845
17,260 cubic yards ditch excavation, at $0.50	8,630
86,950 ties replaced, at $0.50	43,475
46.9 miles ballasting, at $600	28,140
Widening fills and cuts to 15 and 18 feet (approximately)	200,000
New line across upper Trail Lake, at mile 35: 17,990 cubic yards fill, at $0.40	7,196
1,008 linear feet new pile trestle, at $16	16,128
Extra dikes for protection—1,250 linear feet, at $3	3,750
2,142 linear feet (track), track boxes, at $30	64,260
	868,729
Add 10 per cent for engineering, etc	86,872
Total	955,601

Appendix E.—REPORT AND CORRESPONDENCE OF HENRY DEYO, LOCATING ENGINEER, ON RECONNOISSANCE SURVEY FROM CHITINA, NORTHERLY TO TANANA RIVER, NEAR FAIRBANKS, 1910.

CORDOVA, ALASKA, *April 11, 1910.*

Mr. HENRY DEYO,
Engineer Surveys, Copper River & Northwestern Railway,
Chitina Crossing, Alaska.

DEAR SIR: It is desirable to have a thorough reconnoissance survey from the Chitina Junction, through Copper Center, up the Copper and Gulkana Rivers, over the delta divide, and down to the Tanana, through the best route obtainable, to some point on the navigable water of the Tanana River, either above or in the vicinity of Fairbanks. I have been advised that there are extensive deposits of tin ore, coal, and gold quartz on the divide and in the hills, about 60 to 100 miles south of Fairbanks. I would like to ascertain further particulars in this respect and as to the practicability of our line reaching any prospective mineral camps or large agricultural areas in the Tanana district. I would like to have this survey made so as to show distances, approximate gradients, the general character of the work mile by mile, with approximate classifications and class of structures, etc., required. Also, what tie timber or other construction material could be obtained along the line. I would like to have a traverse made in order that the line may be platted on a scale of about 5,000 feet to the inch, making a map similar to that prepared for the Chitina branch. As much of the country as possible should be sketched in, with bearings to prominent landmarks. The skeleton profile may also be prepared, showing the approximate grade of elevation, on a scale of 5,000 feet to the inch for horizontal measurements. I would like the survey to start at the Chitina town site and pass up the valley and over the divide, and, if possible, keep on the bench until the Tonsina River is reached. I would like to have this as a comparison with a route which would be a continuance of the line near the Copper River bridge site, and carried along the banks of the Copper River. Where several routes present themselves, please make examination of each in order to determine as fully as possible the best line for construction. With the exception of a possible pusher grade out of Chitina, it would be desirable to confine the gradients to 1 or 1½ per cent if possible. I am anxious for you to become

familiar with every detail of the country between the Chitina and the Tanana, in order that preliminary surveys could be made in the shortest possible time and to avoid the expense of keeping a larger party on experimental preliminary surveys. An approximate estimate of the cost of the work, either mile by mile or in various sections of several miles each, depending upon the character of the ground, should be made.

Ascertain, if possible, what portion of the ground is frozen and where gravel pits or other good material may be obtained. Also, note the location of any mineral prospects or any other natural product which might produce tonnage for the road. Mr. Williams will have a further talk with you in regard to this matter. You are authorized to take such pack animals, sleds, and men as may be required for the expedition. You are authorized to make purchases for material or supplies when required, charging the same to the company. If you consider it advisable, you will be supplied with funds to pay for the services of extra packers or supplies purchased along the line.

Yours, truly,

E. C. HAWKINS, *Chief Engineer.*

REPORT OF RECONNOISANCE SURVEY EXTENDING FROM CHITINA ON THE COPPER RIVER AND NORTHWESTERN RAILWAY NORTHERLY TO TANANA RIVER NEAR FAIRBANKS, ALASKA.

The proposed route has been examined thoroughly during the past season from Chitina to the Tanana River, a total distance of 310 miles. Several possible routes have been examined and compared, and that which has been selected and which forms the basis of this report and estimate is shown on the accompanying maps and profiles.

In starting northerly from Chitina three possible routes are presented: The first, extending directly north from Chitina through a pass in which the wagon road is located, is rather expensive and involves heavy gradients. The line directly along the bank of the Copper River from the present bridge site is now considered impracticable for the reason that there are about 6 miles of clay and gravel bank that extends into the river. Frequent and heavy slides of this material occur, due to the constant cutting action of the river at the base of the bluffs.

The line that is now considered the most favorable, and which is shown on the map, leaves the present constructed line of the Copper River & Northwestern Railway at the bridge site, and keeps on ground a safe distance back from the river.

From mile 1 to mile 8 the line is about 90 feet above high water. At this elevation the contour of the hill is very straight but with steep slopes measuring about 25 degrees from horizontal.

Miles 4 and 5 are across a valley country. The work would be light.

The grade line on miles 6 and 7 would be about 30 feet above high water.

Mile 8 covers a small bottom of the Copper River. The work would be light.

Miles 9 and 10 would show considerable very heavy work. The grade lines should be placed about 50 feet above high water.

Miles 11 to 20, inclusive, lie on the south side of the Tonsina River. This work will average about 12,000 cubic yards to the mile. The material is earth and gravel, about two-thirds of which is frozen. The Tonsina River is crossed at mile 20. A steel bridge should be constructed, which would require three spans of 150 feet each. It is considered that pile trestle would not hold, owing to the fact that in the fall of the year very heavy ice jams occur and an immense amount of drift is brought down.

Miles 21 and 22 follow the valley of the Tonsina on the right, climbing to an upper branch that lies about 20 feet above the river.

Miles 23 to 26 follow up Willow Creek Valley, which is a small stream, a pile trestle being required. It would be necessary to bridge this stream six or eight times on account of its windings, but none of the crossings would take more than a 60 or 80 foot pile trestle.

Miles 27 to 28 pass through a country that has never been burnt. It is frozen and covered with small spruce. The work will average about 12,000 cubic yards per mile.

Miles 29 to 37, inclusive, pass through a country that has been burnt over and is covered with a growth of quaking aspen and willows. The ground appears to be thawed out and the soil is a good sandy loam. It is believed

that this bench in time will make a good farming country. The work will average about 7,000 cubic yards per mile.

Miles 38 to 43, inclusive, passed through a country that has never been burnt. It is covered with a growth of small spruce. This should be burnt over, as it is useless in its present condition, the timber being worthless. This work will also average about 7,000 cubic yards per mile.

On mile 44, there is about 40,000 cubic yards of frozen earth and 400 feet of pile trestle. On mile 44 is the summit of the grade where the line descends to the Klutina River crossing. A gradient of 1.75 is used, which seems to fit the country, although there is a possibility of getting this down to 1.5 per cent.

On miles 45 and 46 the average will be about 15,000 cubic yards per mile. Most of the material is frozen earth and clay.

The line crosses the Klutina River at a point about 1½ miles above Copper Center, and the grade elevation will be about 135 feet above Copper Center. From the crossing of the Klutina River to the Taslina the line is along a high bench that lies west of the Copper River. Very favorable conditions prevail. The work is light and the material fairly good.

At mile 59 it will be necessary to change the channel of the Taslina River. The material through which the cutting for the new channel will be made is very light gravel and clay. After cutting of a channel 100 feet wide the action of the water will sluice out channel to sufficient width.

The Taslina is crossed at mile 61, about 200 feet east of the mouth of Moose Creek. This is a good crossing and the best that is to be had on the river. At this point the river is confined in one channel about 350 feet wide, and the banks on both sides show no evidence of cutting. From the Tasina River the line will follow up Moose Creek for about 4 miles. It will be necessary to cross the creek a number of times. It is a small stream, and 60-foot pile trestles will answer every purpose.

At mile 65 we are on the top of a bench, and from there to mile 106 the work of grading will be extremely light. On this bench country there are numerous small lakes and a number of grassy sloughs, but they are not swampy. There was no difficulty in getting the horses through this country, although we had been advised that it would be impossible to get stock through on account of the numerous floating swamps that would be encountered. This extensive bench country is covered with a growth of scrub spruce and willows.

The line crosses the west fork of the Gulkana at mile 107. This crossing will require one 150-foot through span. From the crossing of the west fork to the summit on mile 125 the work is very light, with practically no bridging. Fourth of July Summit at mile 125 is a very broad pass, with an elevation of about 3,500.

From mile 125 to 135 the country is cut up into small pockets and hills. The material is a very fine gravel, with very few bowlders or gravel larger than 6 inches in diameter.

The line from mile 135 to 153 crosses numerous tributaries of the Delta River, but they are all small, clear water streams.

At mile 153 the delta forms a box canyon, and at this point it will be necessary to take a 700-foot tunnel. In this canyon there is a fall of the river of about 95 feet.

Miles 153 and 154 will show heavy work owing to the fact that there is no support on the side of the canyon for about 2½ miles, until the bottom land is again reached. The excavation encountered will be in solid rock. It is the first since leaving the Tonsina River.

From mile 155 to 163 the line follows along the west side of the Delta River. There is a valley most of the distance, and where there is not the line will follow the smooth slope that will not exceed 10°.

At mile 163 the line crosses the mouth of Canyon Creek. This is a glacial stream and carries considerable more water than does the Delta at this point. Canyon Creek at the mouth is confined to one channel, about 100 feet in width. It is 3 feet deep and flows at a velocity of 8 miles per hour. It carries no drift, and a pile trestle could be maintained.

From mile 164 to 166 there is considerable rockwork, mostly along the cliff side.

From mile 166 to 185 the valley extends about half way. For the remainder of the distance the line will follow smooth slope of about 10°. At mile 185 the line crosses the stream that drains the rapids glacier. This stream is 150 feet wide and very swift. It is a typical glacial stream, but has evidently been confined in the same channel for a number of years.

From mile 185 to 190 the line is in a broad valley. At this last point we leave the mountains and reach the broad level valley on the west side of the delta. This extends northerly as far as the eye can discern. The line would follow the west side of the delta to its mouth, then down the south side of the Tanana to the mouth of the Little Delta, on mile 255. From this point to the terminus of the survey at mile 310, on the south bank of the Tanana River, opposite Chena, the line would be across the valley of the Tanana River and across a country that would require very little curvature. The line from mile 190 to 310 will average about 14,000 cubic yards of earth to the mile, 50 per cent of which is probably frozen and 50 per cent probably thawed. Bridges will average about 300 feet in length of pile trestle per mile.

For estimated cost see statement herewith, and for gradients and topographical conditions please refer to profiles and maps.

NATURAL RESOURCES NEAR FAIRBANKS.

(Mr. Deyo further reports on general conditions, as follows:)

When I started on this trip I was skeptical as to possibilities of farming in the Tanana Valley, but I am now as enthusiastic as anyone can be. I have visited the Government farm here and a number of other farms that have been put on a paying basis. I have seen spring wheat that was planted on April 25 that is now ready to harvest. I have seen fields of oats, barley, and rye as good as I have seen in the States, and all of the hardier vegetables are raised as well as they are in any farming country. Farming here has passed the experimental stage and is now an assured fact.

I have looked at the quartz properties that have been developed to any extent worth mentioning. I think there is no question that the country will in time develop into a quartz camp. There is a 10-stamp mill at Fairbanks that is running day and night. The ore milled runs from $20 to $2,200 per ton in gold, and the mill saves but 50 per cent of the values. Eleven tons of ore taken from the Brodes property at Bedrock Creek, sent to Tacoma, went $420 per ton. The Brodes people have 150 tons of ore on the dump. They have drifted on the lead for 575 feet and have struck a fault, losing the vein, although there is no doubt in my mind but that they will again pick it up. The vein is about 2 feet in width.

The B. & P. property on Chatham Creek is the most developed, but is now closed down on account of litigation. The working shaft follows the vein 165 feet. The vein is 7 feet in width, and I am told the ore runs $32 per ton.

The Jupiter and Mars on Chatham Creek have a vein about 1 foot wide and of very high value. The shaft is now 50 feet deep. They are putting in a hoisting plant and will make a good showing in the next few months.

The McCarthy property on the head of Fairbanks Creek has a shaft sunk to a depth of 50 feet, and have drifted on the vein 30 feet. The vein is now 1 foot in width. They have uncovered the vein in the surface for about 1,000 feet. Mill tests on several tons ran $125 per ton.

The Spaulding property at the head of Dome Creek has a shaft 55 feet, and the vein will average 3 feet in width. The ore averages by mill run $52 per ton. The vein has been uncovered on the surface at different places for 2,000 feet.

A mining property (name unknown) on the head of Skoogy Gulch has a tunnel driven 164 feet. They have about 4 feet of ore that will run $50 per ton. A 10-stamp mill and concentrator is now being built at Chena. They propose to furnish transportation and mill the ore for $10 per ton.

It is probable there will be sufficient development during the winter to justify the company in sending in a mining engineer whose judgment would be better than mine in all these matters pertaining to mining development.

Preliminary estimate for construction of standard-gauge railway from Chitina to Tanana River, near Fairbanks.

[Based on reconnoissance survey made by C. R. & N. W. Ry., 1910.]

(60-pound rail and native ties.)

Grading:		
305,000 cubic yards solid rock, at $1.50	$457,500	
80,000 cubic yards loose rock, at $0.80	64,000	
1,941,000 cubic yards frozen earth, at $1.20	2,329,200	
2,101,000 cubic yards earthwork, at $0.50	1,050,500	
		$3,901,200

Clearing 2,209 acres, at $50 to $75	$150,000
Tunnels, 945 linear feet, at $60	56,700
Pile trestles:	
46,800 linear feet, at $10	468,000
1,350 linear feet, at $12.50	16,875
Culverts, 25,000 linear feet, at $4	100,000
Steel bridges, 6 spans, 150 to 200 feet each, 1,050 linear feet, 1,223 tons	315,000
Telegraph, 310 miles, at $350	108,500
Water supply, 21 tanks	100,000
Section houses, etc., 31 at $3,000	93,000
Station buildings, 15	60,000
Buildings, etc., at terminals	200,000
Track, complete, 310 miles, main line, at $9,000	2,790,000
Sidings, 16 miles, at $15,000	240,000
General expense, including engineering, legal and incidental	1,000,000
Total	9,599,275
Average cost per mile (exclusive of equipment)	30,956

[Copies of letters of Henry Deyo, locating engineer, while making reconnoissance survey, Chitina, northerly to Tanana River, near Fairbanks, 1910.]

RAPIDS ROADHOUSE, *July 18, 1910.*

Mr. ALFRED WILLIAMS,
Assistant Chief Engineer, Cordova, Alaska.

DEAR SIR: I have looked up the country pretty thoroughly between Copper Center and the Rapids Roadhouse on the Delta River. Although there is a country that lies between the mouth of the west fork of the Gulkana and Summit Lake that I want to look up more thoroughly on my way out this fall. In looking up the pass through this range I followed the main range west to the head of the McLaren River, a tributary of the Sushitna, in hopes that I could find that the Little Delta broke through to the south side of the range, but there was no show.

The inclosed Government map shows an approximate location of where I think the line should lie; also shows quantities, bridges, etc.

From Copper Center, or the crossing of the Klutina River, to the Taslina we keep on the high bench that lies west of the Copper River. We get good ground over that country, light work, and good material to handle. At mile 59 it will be necessary to channel the Tazlina River. At the place we should channel there is only 200 feet difference in elevation. The material that we would cut through is a very light gravel and clay, and by cutting, say a channel about 100 feet wide and start the water through, with the 20-foot fall it would soon sluice out a large enough channel for the whole river. We cross the Tazlina River at mile 61, about 200 feet east of the mouth of Moose Creek. It is a good crossing and the best to be had on the river. At this crossing the river is confined to one channel about 350 feet wide, and the banks on both sides show no evidence of cutting; although there was unusually high water last year.

From the crossing of the Tazlina River we follow up Moose Creek for about 4 miles. It will be necessary to cross Moose Creek a number of times, but it is a small stream and a 60-foot pile trestle would take care of it. At mile 65 we are on top of the bench and from there to mile 106 we will have very light work. On this bench country there are a good many small lakes, and quite a number of grassy sloughs, but they are not swampy. We had no difficulty in getting our stock through this country, although I had been told by quite a number of people that it would be impossible to get through with stock, owing to the floating swamps; but it proved to be the best country that we had to get over.

It was impossible for us to make a complete map of this bench country with the means that we had to work with. It is covered with a growth of scrub spruce and willows. We cut one line through from Tazlina to Ivan Lake, and worked from that. We got our location by taking reading on Mount Drum and Sanford. You will notice that the Gulkana River is 8 or 10 miles from the position the Government map shows it to be. We cross the west fork of the Gulkana

at mile 107. This crossing will take one 150-foot through truss. From the crossing of the west fork of the summit, mile 125, the work will be very light, with practically no bridges. Fourth of July Summit at mile 125 is a very broad pass. The elevation is about 3,500. From mile 125 to 135 the country is cut up with little pockets and hills. The material is very fine gravel, very seldom one sees a rock that would measure over 6 inches in diameter. Mile 135 to 152 we cross through tributaries of the Delta, but they are small, clear-water streams. At mile 153 the Delta forms a box canyon, and at this point it would be necessary to take a 700-foot tunnel. At the head of this canyon there is about a 95-foot fall. Mile 153 and 154 will show pretty heavy work, owing to the fact that we have to support on the side of the canyon for about 2½ miles before we reach bottom again. This is the first solid rock in place that we have encountered since we left the Tonsina River. From mile 155 to 163 we follow along the west side of the Delta River. There is a valley most of the distance, but where there is not the line would be following a smooth slope that would not exceed 10 degrees. At mile 163 we cross the mouth of Canyon Creek. Canyon Creek is a glacier stream and flows considerable more water than the Delta does at this point. Canyon Creek at its mouth where the water is confined in one channel is about 10 feet wide, 3 feet deep, and flows at a velocity of 8 miles per hour. It carries no drift and a pile trestle would handle it.

From mile 164 to 166 there would be considerable rockwork, mostly cliff work. From mile 166 to mile 185 there is a valley about half the way; the line the balance of the distance would follow a smooth slope of about 10°. At mile 185 we cross the stream that drains the Rapids Glacier. This stream is about 150 feet wide, very swift; is a typical glacier stream, but is confined to one channel and has evidently held the same channel for a number of years. From 185 to 190 is a broad valley. At this point we get out of the mountains, and there is a broad level valley on the west side of the Delta as far as we can see.

The last letter received from you was written June 11. There is no summer mail between Gikana and Fairbanks. I expect to be in Fairbanks in about 10 days or two weeks. As soon as I reach Fairbanks I will look up the quartz and coal that Mr. Hawkins mentioned in his letter.

Yours, truly,

HY. DEYO.

I will send you the map and profile under separate cover.

FAIRBANKS ALASKA, *August 6, 1910.*

Mr. ALFRED WILLIAMS,
Assistant Chief Engineer, Cordova, Alaska.

DEAR SIR: A very light line can be had from the Delta Rapids to Fairbanks, a distance of 110 miles, or 300 miles from Chitina. In coming through to Fairbanks we crossed the Delta at Donnelly, a point about 36 miles from its mouth and followed the winter trail through to the mouth of the Little Delta. I sent the horses around by the summer trail, as the winter trail was so swampy it was impossible to get horses over it.

I thought it possible for a line to leave the Delta at Donnelly and strike the Tanana River at the mouth of the Little Delta and save about 11 miles in distance, but after going over the line I don't think it practical. I think a line should follow the west side of the Delta to its mouth, thence down the south side of the Tanana to the mouth of the Little Delta, and future developments would tell whether you would want to use it.

I don't want to make a report on the country between the Delta Rapids and Fairbanks until I go over it more thoroughly; which I will do on my way back.

I have received a message from Mr. A. N. Gray requesting me to await his arrival at Fairbanks. I wired him that I would wait for him at the mouth of the Little Delta.

There are good reports coming from the Bonnifield country, and I want to put in about 10 days there, as I think that is the country that will furnish the big tonnage.

Yours, truly,

HY. DEYO.

CASEYS CACHE, *September 3, 1910.*

MR. ALFRED WILLIAMS,
Assistant Chief Engineer, Cordova, Alaska.

DEAR SIR:A line from the rapids to Fairbanks (or mile 190 to 300) will average about 14,000 yards of earth per mile; 50 per cent frozen and 50 per cent thawed. Bridges will aveage about 300-foot pile testle to the mile.

I am not in shape to build a map here and will go over it thoroughly when I get out. I expect to reach Cordova in about three weeks. To-day I go up the west fork of the Deta, as I want to look up the country more thoroughly between the summit and the west fork of the Gulkana. As soon as I reach the Gulkana will go over to the Government trail and look up the country between Paxsons and Gulkana.

Yours, truly,

HY. DEYO.

Appendix F.—REPORT ON KUSKOKWIM RECONNOISSANCE.

[By J. L. McPherson.]

NOTE.—A general map on a scale of 1 to 250,000 and a profile on a horizontal scale of 10 miles to 1 inch are appended. Also, a few typical photographs are appended at the end of the report. All other maps and photographs referred to have been omitted from the report. They are on file in the general office.

The Kuskokwim reconnoissance had for its object a general investigation of the Kuskokwim route, covering as many of the alternative and branch routes as time would permit. This route extends from a junction with the Susitna-Tanana route, in the lower portion of the Susitna Valley on the south coast of Alaska, northwesterly through western and northwestern Alaska. Its improvement will result in the opening up and development of the western portion of the Susitna, the Kuskokwim, Innoko, and lower Yukon basins, with their tributary valleys and in its ultimate projection to the northwest, the development of the Seward Peninsula.

With the exception of the open season of from three to five months during the summer, when Bering Sea and the rivers of the interior are open to navigation, the only means of transportation now available through this portion of Alaska are the meager facilities afforded by a winter trail that has been cut and marked along the Kuskokwim route. The development of western and northwestern Alaska is dependent upon the improvement of this route as a connection from any of its interior tributary regions to any interior point on the Tanana route will be as long as the through distance to the south coast over the Kuskokwim route, while such connections would, in general, parallel water routes.

The Kuskokwim route is at right angles to the main drainage and will supplement water transportation, thereby providing ideal conditions for the development of the adjacent country.

In fixing on a location over this route consideration should be given to future extensions and branch lines that will the more economically develop the surrounding country and to the ultimate extension of the route to the northwest and the Seward Peninsula.

PREVIOUS EXPLORATIONS.

The first exploration of any portion of this route was by J. E. Spurr and W. S. Post under the direction of the United States Geological Survey in the year 1898. This party ascended the Susitna, Yentna, and Skwentna Rivers to Portage Creek, which flows into the Skwentna about 7 miles above the mouth of Happy River. Ascending Portage Creek they crossed the Alaska Range through a pass at its head which leads into the Ptarmigan Valley. The elevation of this pass is given as approximately 4,400 feet, or about 1,700 feet higher than Houston Pass at the head of the Happy and Ptarmigan Valleys. Descending to the south fork of the Kuskokwim, this river was followed to the Kuskokwim, which was traversed to its mouth. The report of this exploration is contained in the Twentieth Annual Report, part 7, of the United States Geological Survey.

In 1899 Lieut. J. S. Herron, in charge of an expedition under the War Department, ascended the Susitna and Yentna Rivers to the Kichatna, which

A. GRASS MEADOW, BIRCH AND SPRUCE COVERED RIDGE BETWEEN SUSITNA AND KAHILTNA RIVERS.

B. RED TOP GRASS, 5 FEET HIGH, SHELL HILLS.

A. VIEW OF THE TANANA RIVER NEAR ITS CONFLUENCE WITH THE LITTLE DELTA.

B. LOOKING DOWN HAPPY RIVER VALLEY.

was followed to its source. This expedition crossed the Alaska Range through Simpson Pass, then down Earl Creek and the Tatina River to the South Fork of the Kuskokwim, which was followed to its junction with the North Fork, thence up the latter and down the Kantishna to the Tanana, an account of the trip being embraced in War Department Reports on Explorations in Alaska, 1899, No. 31.

Rainy Pass was discovered in 1902 by Alfred H. Brooks, in charge of an expedition under the United States Geological Survey. This party crossed through the Beluga Mountains to the Skwentna River, thence across Shell Hills to the Kichatna River, up the latter to its head and down Moose Creek to Happy River, and across the Alaska Range through Rainy Pass, thence down Dalzell Creek and the Tatina River to the South Fork of the Kuskokwim River, thence northeasterly through the foothills of the Alaska Range into the Tanana Valley, account of the trip being embraced in United States Geological Survey, Professional Paper 70.

In 1906 and 1908 the writer covered portions of the Kuskokwim route in its extension to the northwest—in 1906 in charge of the reconnoissance survey from Fairbanks to Nome, under direction of the Alaska Road Commission, report of which is embraced in Senate Document No. 214, Fifty-ninth Congress, second session. This survey crosses the extension of the Kuskokwim route at the head of Norton Bay.

In 1908, on reconnoissance of the Alaska routes, under direction of the Alaska Road Commission, the writer covered the Kuskokwim route from Kaltag, on the Yukon River, across the Kaiyuh Mountains by way of the pass near the head of the Kluklaklatna Creek, and down the latter to the Innoko at Dishkakat. In 1909 and 1910 the Alaska Road Commission cut and marked a winter trail along this route, crossing the Alaska Range through Rainy Pass.

The Innoko-Iditarod region was covered by reconnoissance survey under direction of the United States Geological Survey, report of which is embraced in their bulletin No. 578.

Seward Peninsula has been very fully mapped by the reconnoissance surveys of the United States Geological Survey, reports of which are embraced in their various publications.

RECONNOISSANCE FOR ROUTE.

The result of these various explorations and reconnoissance surveys developed the fact that a practical railroad route existed through this region, but as it had not been studied from a railroad standpoint, no reliable data was available as to points of control, while through the Alaska Range 4 passes were known to exist in a distance of about 30 miles. These conditions made the reconnoissance one of route more than detail. As it was necessary to get through to the waters of the Iditarod or Yukon before the close of navigation, no time was available for a return study over portions of the route where alternative lines existed or where the control would throw the line elsewhere than along the route followed.

PORTION OF ROUTE COVERED.

The reconnoissance commenced at a point on the Seward-Fairbanks route in the vicinity of Willow Creek on the east side of the Susitna Valley, thence west through the Susitna, Yentna, Skwentna, and Happy River Valleys to the headwaters of the latter stream in the Alaska Range. This range was covered for a distance of about 30 miles along its axis, and Simpson, Rainy, Teocalli, and Houston Passes, with their approaches, investigated. Completing this investigation, the valley of the South Fork of the Kuskokwim River was followed to Farewell Mountain, thence westward across the basin of the forks of Big River and the Kuskokwim to McGrath at the mouth of the Takotna River, thence up the Takotna Valley to the Innoko Divide, and by the Takotna, Moore Creek, and Bonanza Creek Valleys to Iditarod. Two diverging lines were carried across the Susitna Basin from 4 to 16 miles apart.

ORGANIZATION.

The party was organized as follows:

J. L. McPherson, reconnoissance engineer; C. P. Dexter, assistant engineer and topographer; G. G. Blake, topographer; C. T. Chenery, recorder and gen-

eral assistant; Joseph Martindale, general assistant; Mark Nichols, general assistant; Robert Reed, packer; J. A. Denny, packer; E. Perry, cook; and Edward Mullen, packer, who returned to headquarters after the first month.

Our supplies, which with equipment made a total weight of about 4,600 pounds, had to all be transported from the Susitna end. About 3,000 pounds of this weight I was able to transport by launch to the mouth of the Skwentna, so that it was only necessary to relay our outfit for about 10 days out from this point.

The pack train consisted of 20 horses. Although the loads for such a trip were light, the greater number of the horses weakened rapidly, and by the time the frost had killed the grass in early September, we had only seven that were capable of any packing. These I was able to land at McGrath by rafting them down the Pitka Fork, Big River, and Kuskokwim. The failure of the horses I assign to the cold, rainy weather that prevailed throughout the trip and to their being unused to the country and conditions. For the first six weeks their work, for such a trip, was light, as our progress was very slow, owing to the dense undergrowth through which a way had to be chopped. During this period the work of the horses probably did not average over three hours a day. For the latter part of the trip the loads were light, but the travel was heavy and marshy. The horse that carried the heaviest load throughout was the one to reach McGrath in the best condition. There was an abundance of feed at all camps, with the one exception of the locality at the mouth of the Tatina River. In fact, I know of no locality in Alaska where such a luxuriant growth of native redtop grass can be found.

METHOD OF SURVEY.

Owing to the lack of any accurate control through the section to be covered, I had planned and was prepared to carry through a magnetic stadia survey for control of distance and elevations. This was started and carried for about 20 miles, when it was necessary to abandon it owing to the density of the undergrowth, which we found would require as much chopping for a stadia line as it would for a preliminary. All of the available help I had was required in cutting a way for the pack train. It was then too late in the season to reorganize my party with additional help, which would have required more supplies and pack animals. Finding that the foot traverse, as independently carried by G. G. Blake, was checking close enough for all practical purposes with the stadia line, the remainder of the line was carried entirely by foot traverse.

In a distance of about 10 miles down Willow Creek the check between Blake's foot-traverse line and the stadia line was within 500 feet. Experience in this work has developed the fact that with proper care and training, results of from 1 to 2 per cent of accurate should be secured. The chance for greater error I find to be in the platting of the notes to a small scale in the field. This can be obviated by a calculated check of the work daily, which I would recommend for any such lines.

All bearings were taken to fixed points with a prismatic compass. The lines were platted and topography sketched in the field. Elevations were approximated from barometer readings relayed between camps. Observations for azimuth and latitude were taken whenever weather conditions would permit, which, unfortunately, due to cloudy weather, was not very often.

Although the methods of survey were not as accurate as could be desired, especially over such a long distance where little accurate control was to be secured, it was the only method by which it was possible to cover the distance in the time and with the assistance available. From the checks that we were able to secure on the various portions of the work, and the final check on the position of Tacotna and Iditarod as determined by the United States Geological Survey, the results should, I believe, be within 1 or 2 per cent of accurate over all sections except the distance from McGrath to Takotna, about 15 miles in a direct line. This distance was covered only by boat traverse up the Takotna River. The reconnoissance covered a total of 726 miles, as follows:

	Miles.
Stadia lines	26
Foot traverse	545
Boat traverse	155

ITINERARY.

The party left Ship Creek June 18 and Knik June 20. The line of survey of the Alaska Northern Railway was followed to Willow Creek, a distance of about 46 miles, which was reached on June 25, high water on the Little Susitna, windfalls, and miring mudholes greatly retarding our progress.

June 26 was spent in a reconnoissance of the country to the north of Willow Creek. On June 27 the reconnoissance started down the valley of Willow Creek, reaching the Susitna on the 30th. Sunday, the 28th, was taken as a day of rest, the only day's rest until September 24, our arrival at Iditarod. On two days we were held in camps above timber lines by severe storms, with conditions so disagreeable that no rest was possible.

July 1 to 7 was spent in an examination of the Susitna River between Susitna Station and Kashwitna Creek.

On July 8 I dispatched a light topographical party, consisting of Messrs. Blake, Denny, and two Indians, to carry a line west from Susitna, opposite the mouth of the Kashwitna, to the Kahiltna River. On the same day the remainder of the party crossed the Susitna at the mouth of Kroto River, which I found to be the most suitable point for a crossing of the Susitna between the mouth of the Yentna and the Kashwitna. The Kahiltna River was reached on the 13th and the Yentna River crossed on the 17th at the mouth of the Skwentna.

Although our progress so far had been much slower than I had anticipated, owing to the dense undergrowth encountered, we found conditions even worse in the Skwentna Valley, and we did not reach Happy River until August 9, a distance as traveled from the mouth of the Yentna of about 63 miles, or an average of less than 3 miles per day. Through this valley and along the Shell Hill benches we had to cut through many miles of dense, intertwined alder, where the growth was thicker than anything to be encountered in Alaska. For the greater portion of this time four axmen were continually employed in cutting trail.

Rainy Pass was crossed on August 14, and on the 17th we had reached the South Fork of the Kuskokwim River at the mouth of the Tatina. Not finding conditions suitable for a railroad location through Rainy Pass, I cached all of my extra supplies in the unoccupied roadhouse at this point, and with about two weeks' supplies started on a traverse that would embrace all the known passes through the range.

Ascending the valley of the South Fork of the Kuskokwim, we discovered on the 19th a break in the range to the east that seemed to indicate a possible pass. August 20 was spent in the investigation of this region, discovering on that day the pass that I named Teocalli, after the name of the mountain range. Returning to the South Fork of the Kuskokwim, we continued up this river and its tributary, Ptarmigan Creek. We recrossed the summit at the head of the latter stream through a big, broad divide, which I named Houston Pass, in honor of Judge Houston, chairman of the House Committee on the Territories.

Thence we followed down Happy River to the mouth of Moose Creek and up the latter to Simpson Pass, which was crossed on August 27; thence down Earl Creek and the Tatina River to the South Fork of the Kuskokwim, which we reached on the 29th.

August 30 and 31 were spent in traversing the valley of the South Fork of the Kuskokwim to Farewell Mountain, where we turned westward across the Pitka Divide into the basin of Big River. After leaving the gravel terranes along the west slope of the Pitka Divide the travel becomes very heavy through tundra-covered marshes and overflowed creek valleys. Owing to the weakened condition of the horses, which failed rapidly during this period, we did not reach Bear Creek until September 5, the last three days covering only 10 miles. Bear Creek being high, I loaded all the outfit possible into the canvas boat and took it downstream to the Pitka Fork, picking up the party at the mouth of Salmon River. Finding the winter trail through this section to be absolutely impassable for horses, and my remaining head of stock too weak to travel farther, I devoted the following five days to building three rafts on which to transport the horses and outfit via Pitka Fork, Big River, and the Kuskokwim to McGrath.

From a point about three-quarters of a mile above the mouth of Salmon River, which, according to existing maps, was on a practically direct line to McGrath, I sent a light reconnaissance party overland under C. P. Dexter, on a

line which the map showed to be a direct line to McGrath and the Takotna Valley, our objective point.

The rafts were three days floating down the waters of Pitka Fork, Big River, and the Kuskokwim, along which we carried a boat traverse, estimating our progress in feet per second, based on foot traverse averaging about one-half a mile in length and taken from four to six times each day. The rafts reached McGrath on September 14.

The position of McGrath, as shown by the existing maps, I found to be in error, its true position being some 9 miles southwest of where shown. This resulted in our crossing the Big River Basin from 1 to 7½ miles north of a direct route. The conditions over a more direct route, I think, will be found to be very similar to those which we found along the line covered.

Finding that it would be impossible to get the remaining horses over the route of the winter trail which followed the valleys of the Takotna, Moore Creek, and Bonanza Creek, which I desired to cover, and that I would probably find most of the road houses open, I disposed of the remaining seven horses at public auction on the 16th.

The 18th was devoted to an investigation of the Innoka Divide, and on that evening at Takotna we were overtaken by C. P. Dexter, who had reached McGrath the night of our departure.

Leaving Takotna on the 19th, we continued up the valley of the Takotna to the Moore Creek Divide, near its head, thence down the North Fork of Moore Creek, and up the South Fork of Moore Creek to the Moore-Bonanza Creeks Divide, across this divide, and down Bonanza Creek to Ruby Creek, which we reached the 22d.

Understanding that the last boat would leave Iditarod on the 25th, we crossed the divide between Bonanza and Otter Creeks to Flat City, and thence over the wagon road to Iditarod, which we reached on the 24th. There we learned that we would have about three days' delay before the departure of the last boat, time which could have been most profitably employed in continuing the traverse down the valleys of Bonanza Creek and Iditarod River could I have known of this delay before leaving Bonanza Creek.

From Takotna to Iditarod foot traverse was carried through and topography sketched by Blake and myself. The other members of the party had packs varying in weight from 18 to 25 pounds.

We departed from Iditarod by boat on September 27, but did not reach St. Michael until October 5, due to stormy weather, being stormbound off Stebbin Point for three days. By steamer *Victoria* we left St. Michael on October 5 and arrived in Seattle October 15.

WEATHER CONDITIONS.

Of the 98 days from June 20 to September 25, 33 days were bright, 25 were cloudy, on 40 we had rain, and on 8 days heavy storms. The season was the wettest I have experienced in the Alaska interior, the waters in the rivers and creeks high throughout the entire distance, and during a considerable portion of the time the rivers and creeks overflowing into the swamps. The Kuskokwim we found to be 12 feet higher than ever known at that season of the year. Native redtop grass was found growing in many places where the ground was covered with a foot of water, going to show that the conditions were exceptional. Moving camp daily under such weather conditions is trying on the spirits of the most cheerful, and it speaks well for the members of the party that they had the dispositions to endure these conditions uncomplainingly.

GENERAL FEATURES OF ROUTE.

The Kuskokwim route, being generally at right angles to the main drainage, is ideal from a development standpoint, as it supplements water transportation. This condition results in many river crossings, which will be the big item of cost in the construction of a railroad. Houston Pass, at the head of Happy River, provides a low crossing of the Alaska Range, with light approaches and easy grades. Heavy work will be encountered over a total distance of about 7 miles through the canyon of the South Fork of the Kuskokwim River and in supporting down into the valley. Through the Happy River Valley crossings of three high gulches and a number of minor ones will be necessary.

Aside from these features the route offers no engineering difficulties, and maintenance charges for an Alaskan railroad will be low.

KUSKOKWIM RECONNOISSANCE—MOUNTAIN PASSES.

The primary point of control of a railroad location over the Kuskokwim or northwestern route through Alaska is the crossing of the Alaska Range, a high crescent-shaped range of mountains extending through Alaska and separating the interior and western regions from the southern portion.

The only break in this range of mountains between Broad Pass at the head of the Susitna and Nenana Rivers and the Iliamna and Lake Clark region, a distance of about 340 miles, is the broad depression at the head of Happy River. This depression extends for a distance of about 30 miles along the mountain axis, with summits averaging from 5,000 to 6,000 feet in elevation. North of this region the summits rise abruptly with ice-covered slopes, reaching an extreme elevation of over 20,000 feet at Mount McKinley.

To the south the change, although not so abrupt as to the north, is very marked, the extreme elevation of over 11,000 feet being reached at Mount Spurr. South of Mount Spurr the range rapidly decreases in elevation, merging into the lower range of mountains that extend southwesterly along the Alaska Peninsula.

In a broad depression at the head of Happy River four passes were known—the pass at the head of Portage Creek (crossed by Mount Spurr and which, due to its high elevation, need not be considered), Houston Pass at the head of Happy River, Rainy Pass, Simpson Pass, and Teocalli Pass, which we discovered.

HOUSTON PASS.

Houston Pass is a broad, rolling divide at an elevation of approximately 2,720 feet above sea level, at the head of Happy River and Ptarmigan Creek, the latter a tributary of the South Fork of the Kuskokwim River. The advantages of this pass are, briefly, lowest elevation, light construction, easy approaches, and low cost of maintenance. Its disadvantages are greater distance over all others and a greater length above timber line, which will entail the construction of many miles of snow fences as a protection against drifting snow. This length I have approximated at 60,000 feet. This latter disadvantage I do not consider by any means a serious one, and the advantages are so great, as compared with the difficulties met in the other passes, that I do not think there can be any question as to Houston Divide being the proper crossing for any railroad location through this section. Through the canyon of the South Fork of the Kuskokwim River and in supporting down into the valley heavy work will be encountered over a total distance of about 7 miles, but which is lighter than would be encountered by any of the other passes. This will be along fairly regular slopes of from 15 to 35° where no difficulty should be had in maintaining the line and where there is no evidence of snowslides.

The formation is of shale and sandstone, the small slides from which are of large, angular fragments and blocks.

The disadvantages of greater length by this route is partly overcome by the accessibility which it affords to the valleys of the upper South Fork of the Kuskokwim River and Hartman River, in the regions of which indications of mineral have been discovered.

RAINY PASS.

The more direct route across the Alaska Range is via Rainy Pass, the elevation of which is approximately 3,350 feet above sea level. The formation of this region is a fine grain, black slate which disintegrates and weathers into small particles. The rounded slopes of the mountains are covered in great part with talus slides of this fine material over which it would be impossible to support any line. A line over Rainy Pass on a 2 per cent grade I believe to be impracticable, as such a line would have to be supported high up on the mountain side where many of these talus-covered slopes would be encountered. The only possible line through this section would necessitate a tunnel about 17,000 feet in length. To the east portal of this tunnel the approach would be easy, along the valley floor of Pass Creek. From the west portal of the tunnel heavy work would be encountered over the greater portion of the distance into the valley of the South Fork of the Kuskokwim. It would be necessary to develop, I estimate, about 6 miles of line in order to secure the required grade, and it is very questionable whether portions of this line would not fall on these talus-covered slopes. The length of such a line, from

a common point with the route via Houston Pass, I estimate at 30 miles, as compared with 51 miles via Houston Pass. A comparative estimate of cost of these two lines is in favor of the Houston Pass route by a balance of about $1,000,000. In this estimate tunnel construction was estimated at $125 a foot, and extra distance was charged to the Houston Pass route at the rate of $2.50 a foot.

TEOCALLI PASS.

The Teocalli Pass is situated about 8 miles southwest of Rainy Pass. Its elevation is approximately 3,400 feet above sea level. It is approached from the east by a creek valley which flows into Happy River, and from the west by Teocalli Creek which flows into the South Fork of the Kuskokwim.

This pass is in the same formation as that of Rainy Pass, and the same objectionable features of fine talus-covered slopes are encountered. The distance would be longer than by Rainy Pass, and the line would be fully as costly, if not more so.

SIMPSON PASS.

Simpson Pass is situated about 9 miles northeast of Rainy Pass at an approximate elevation of 4,100 feet above sea level. This pass is approached on the east from the valley of Moose Creek, a tributary of Happy River. A more direct approach is by the Kichatna River Valley, a tributary of the Yentna. On the west it is approached by Earl Creek which flows into the Tatina River, the latter a tributary of the South Fork of the Kuskokwim. Any line over this pass I consider impracticable.

By the construction of a tunnel approximately 12,000 feet in length this route might be a possible one. The work down Earl Creek and the valley of the Tatina would be extremely heavy, and I estimate that on such a line between 4 and 5 miles of distance would have to be developed, and it is questionable whether such a line could avoid the talus-covered slopes of slate. As approached by way of Moose Creek from the line up Happy River the cost of construction would be greater than the line via Houston Pass, or even over Rainy Pass, and from this approach need not be further considered. There is, however, a possibility that the approach to this pass via the Kichatna Valley, which undoubtedly would prove much shorter than via the Happy River Valley and Houston Pass, would render the Simpson Pass route worthy of closer study; but as this pass and the upper Kichatna Valley are in a region of high broken mountains, I should judge that any line up the Kichatna would encounter very heavy work.

SUSITNA RIVER CROSSING.

The point of first control along this route is the crossing of the Susitna River. A hurried examination was made of this river by canvas boat from Susitna station, below the mouth of the Yentna to the mouth of the Kashwitna, a distance of about 33 miles. The bounds of any economical connection with the Susitna-Tanana route would cross the Susitna River between the mouth of the Yentna River and the mouth of Kashwitna Creek. At the mouth of Kashwitna Creek the Susitna River with its numerous channels, intervening islands, and bars has a total width of about 1½ miles. From this point downstream to the mouth of Willow Creek the total width varies from 1½ to 2½ miles. Over this stretch of the river the main current is in the west channel, the tendency of the river being to cut in this direction. Below Willow Creek the current swings toward the east and about half a mile above the mouth of Kroto River, the greater amount of water is in the east channel. This section of the river and to a point above the mouth of Kashwitna is known locally as the Kroto Flats. Through this section the river flows through three principal channels with many cross channels and sloughs. The banks are of alluvial deposit, low, and where cut by the current, being rapidly worn away. Any crossing in this section would entail a heavy cost of maintenance, due to the continuous shifting of channels and the cutting away of banks.

The best point for a crossing found in our examination was about one-half a mile above the mouth of Kroto River. At this point the east channel through which the greater portion of the river is flowing has a width of about 940 feet. The current velocity is about 8 second-feet. The east approach would be along the south toe of a gravel ridge 50 feet high. The

middle channel is a shallow overflow channel, about 220 feet wide, flowing along the southeast face of a wooded island. The west channel has a width of about 390 feet. These channels are separated by gravel bars partly overgrown by willow. Between the middle and west channels is a heavily timbered island across the south end of which the line would cross. The west bank is of alluvial deposit and from 6 to 8 feet high. It is quite possible that a more thorough examination of this river would result in finding a more advantageous crossing. Below this point the river widens, flowing through two or more channels, the current being principally along the east bank. Below the junction of the Yentna, the river is flowing in one channel with high permanent banks, from 15 to 40 feet high, and at Susitna Station the width is about 1,400 feet.

A crossing of the Susitna River near the mouth of Kroto Creek will throw the point of economical junction with the Susitna-Tanana route about 5½ miles south of Willow Creek, in the vicinity of mile 115 of Milliken's projection. The land lying between this point and the crossing was not covered, the reconnaissance being down Willow Creek. As viewed from the ends alone, the land is a rolling, marginal valley slope, timbered with spruce and birch. The elevation at the junction of the Susitna-Tanana line is about 450 feet and that at the Susitna crossing about 65 feet. Distance will be lost in crossing this section owing to the rolling character of the ground. The length of the location between these points I have estimated at 13½ miles, which I think will be found to be liberal. The valley of Willow Creek is a level and undulating creek valley with a gentle slope toward the Susitna. Close to the banks of the creek the land is dry and heavily timbered with spruce. Back from the bank the land is marshy. From the mouth of Willow Creek to a point about 3 miles above the proposed crossing the left bank of the Susitna is low and the land back from the bank marshy. For 3 miles above the proposed crossing the river flows along the base of a spruce and birch-covered ridge about 100 feet high, with cut banks for a considerable portion of the distance.

SUSITNA RIVER TO KAHILTNA RIVER.

From the crossing of the Susitna River the reconnaissance followed a practically direct route to the mouth of the Skwentna River, crossing the Kahiltna about 3¾ miles above its mouth. As the region between these rivers was unknown, I dispatched a light topographical party on a line due west from a point on the Susitna River opposite the mouth of the Kashwitna and about 16 miles above the Kroto crossing. This work, shown on map sheets 4A and 4B, was in charge of G. G. Blake. He reported the ground as being low and flat with numerous swampy areas separated by spruce flats and low birch ridges ranging from 10 to 50 feet above the surrounding flats, the drainage being all to the south. This traverse was 17¾ miles long and intersected the Kahiltna River 4½ miles above the line carried through from Kroto crossing. The land between the Susitna and Kahiltna Rivers over the line from Kroto crossing can be generally described as rolling bench land at an elevation of from 60 to 250 feet above the Susitna and Yentna Rivers. The ridges and higher benches are timbered with spruce and birch ranging in size from 6 to 18 inches in diameter. The birch ridges, wherever at all open, are covered with a rank growth of native redtop. The depressions and level flats are marshy and covered with tundra. Nearing the rivers the creek valleys are timbered and comparatively dry. In such sections native redtop grass abounds. From the crossing of the Susitna the route is through the level spruce bottom of the Susitna Valley. Kroto River is crossed about a half a mile from the Susitna. This is a shallow, sluggish stream of swampy drainage. Its width at the crossing is about 270 feet and the depth from 2 to 5 feet. About 3,000 feet from the crossing of Kroto River a bank 60 feet high is encountered at right angles to the route. This will entail a loss of distance of about 3,000 feet. Back from this bank the ground is level and slightly undulating bench land.

The low ridge crossed at mile 22 can possibly be avoided by swinging to the south at mile 19. For about 2½ miles from mile 26 the reconnaissance was through a glaciated pothole region where heavy work would be encountered. A line from a half to a mile south of the line traversed would, I believe, avoid much of this heavy work, as the country appeared to be more regular. Some loss in both grade and distance will be encountered in crossing this section. The loss in distance I have approximated at 9 per cent. No solid rock was noted over this section, material all being glacial deposited débris.

KAHILTNA RIVER TO YENTNA RIVER.

The Kahiltna River is a glacial stream of from 350 to 500 feet wide, with a probable average mean water depth of from 3 to 12 feet. Heading at the foot of the glacier-covered slopes of Mount McKinley and Mount Foraker, it flows southerly into the Yentna River. At Camp 22 it is confined to a single channel 400 feet wide, with banks of silt and gravel 6 to 8 feet high. Between the crossings of the Kahiltna and the Yentna Rivers the line will follow the level valley floor of the Yentna Valley, and, with the exception of that portion around the base of the ridges west of Lake Creek and that portion approaching the Yentna crossing, the line will average about a 3-foot fill. Lake Creek, where crossed, will be about 200 feet wide. This is a clear-water stream, from 1 to 7 feet deep, of lake and swamp drainage. About 2,000 feet east of Lake Creek the line will cross the wagon road leading from McDougall and the Yentna River to the Cache Creek placer district, situated about 35 miles to the north, reference to which is made under the heading of "Resources."

Should the Skwentna Valley route around the south end of Shell Hills be adopted, a possible cut-off that should be investigated would cross the Yentna in the vicinity of the bend 1½ miles above Lake Creek. Such a line would necessitate a crossing of the Skwentna at the south end of Shell Hills, but should result in a considerable saving of distance. Being at right angles to the secondary drainage, a considerable loss in distance over the direct length could be expected. The section between the Kahiltna and the Yentna crossings is timbered throughout with spruce of good quality from 12 to 28 inches in diameter, except in the marshy areas, where it is stunted and scrubby. The per mile estimates for this section vary from 12,000 to 30,000 cubic yards of excavation per mile, averaging for the entire distance about 16,000 cubic yards per mile. This will be of loose material, except along the base of the ridges west of Lake Creek and approaching the Yentna crossing, where solid rock will be encountered.

YENTNA RIVER CROSSING.

The most suitable crossing of the Yentna River in the vicinity of the mouth of the Skwentna is at a point about 1 mile above the mouth of the latter. At this point the river is flowing through two channels of nearly equal width separated by a poplar and spruce covered island with 5-foot banks. At medium stage practically all of the water is flowing in the south channel, into which the main current has a direct entrance. The approach to this crossing is along a 30° to 45° slope, 20 to 40 feet in height, from the top of which the ground gradually rises. This condition will necessitate a skew crossing the north channel, the width of which is about 460 feet. At medium stage there is very little water flowing through this north channel, the average depth on the date of our crossing being from 1 to 4 feet. The south channel of the Yentna River is about 410 feet wide, with banks of sand and gravel about 10 feet high. The south bank will have to be protected by riprap for a distance of from 500 to 700 feet above the crossing, to where the cross current from the outlet of a slough breaks the main current from cutting the bank.

YENTNA RIVER TO HAPPY RIVER.

From the crossing of the Yentna River to the mouth of Happy River are two possible alternative routes, one to the north of the Shell Hills and the other up the Skwentna River and around the south end of the Shell Hills and following the upper bench lying between these hills and the Skwentna River. The latter I was able to investigate only in part. Our line covered the water grade up the Skwentna Valley. This we found to be impracticable. From the Yentna crossing to the base of Shell Hills both lines will be across the level valley floor at the junction of the Yentna and Skwentna Valleys, a line to the north of the hills crossing a greater area of swampy bottom than the line to the south, which would follow the drained land along the bank of the Skwentna River.

The Shell Hills, so named from their resemblance to clamshells, are situated between the lower Yentna and Skwentna Rivers. These hills rise to a height of from 200 to 1,600 feet above the valleys, with rolling slopes of from 10° to 30°. To the east the hills slope directly into the Yentna bottom. To the west they terminate on a level and rolling plateau, which extends west and parallels the Skwentna River to the mouth of the narrow canyon about 9 miles below the mouth of Happy River, where the plateau merges into the foothills

of the mountains. Along the south edge of this plateau the Skwentna River has cut a channel that is from 75 to 300 feet deep. The river is a large and swift glacial-fed stream flowing through a narrow, canyon-like valley varying in width from 300 feet to about 2 miles, the greater part of which is the flood plain of the river. As the river winds back and forth across this constricted area it is continually eating away the small areas of timbered flats which dot the wider portions of the valley.

Where the river cuts into and flows along the base of the slopes bounding the valley, they are bare of timber and sliding. Other portions are covered with timber and undergrowth.

Between the south end of Shell Hills and the mouth of Happy River, the Skwentna flows along the foot of the slope on its north bank for a total distance of about 13½ miles. An aggregate of 10 miles of this distance is along the base of precipitous, rocky slopes from 50 to 150 feet high, which are overlain with glacial and river deposited débris. For the remaining 3½ miles this slope is a sliding deposit of bowlders, gravel, and sand, rangng in height from 50 feet at the south end of Shell Hills to a total of about 300 feet near the canyon. Any line along the base of this slope is impracticable. The conditions along the south bank of the river are equally prohibitive, rendering impracticable the location of a water grade up the valley.

The plateau or bench lying between Shell Hills and the Skwentna River is a rolling flat with low, irregular ridges separated by marshy flats and shallow depressions. Draining southerly across this plateau are four large creeks: Shell, Tenmile, and the two indicated at the east end of map sheet 10. These creeks have cut deep, narrow gorges, and any line around the south end of Shell Hills and across the plateau will have to keep well back to avoid these depressions. With the exception of the marshy flats the land is covered with a heavy growth of spruce and birch timber and a dense undergrowth. The Skwentna River edge of this flat is covered with a dense growth of intertwined alder which extends back from the edge of the slope for a distance, in places, of from a quarter to three-quarters of a mile. A practicable route can, I believe, be found to the north of Shell Hills, which are apparently separated from the foothills by a low divide. It is certain that such a route will result in a loss of grade, but from what could be seen of this region from a distance, it appeared likely that a location could be secured through this section that would be shorter and no more expensive than one around the south end of the hills. This section will require extended and careful study, as it is all heavily timbered and of a rolling character. Reconnoissance for detail should cover both of these routes before any preliminary survey is made. Our progress up the Skwentna Valley was so slow, due to the dense undergrowth through which we had to cut a way, that no time was available for a more thorough investigation of this section. From the Yentna crossing to the base of Shell Hills about 4 miles will be made through spruce bottom and about 3½ miles across spruce and open marshes, requiring a fill of from 3 to 5 feet, the material for which can, I believe, be more economically secured from the base of Shell Hills.

From the crossing of the Yentna to the mouth of Happy River via the route north of Shell Hills, the distance in a generally direct line is about 41 miles. The loss of distance from the base of Shell Hills will probably be considerable. In my estimate I allow for a loss of 15 per cent in distance over this section, which I estimate will average about 25,000 cubic yards per mile. A line around the south end of Shell Hills and across the plateau will be probably 3 or 4 miles longer than a line to the north.

For the last 9 miles and to a point opposite and north of the mouth of Happy River, the line will be over rolling and irregular slopes and benches, lying between the base of the mountains and the abrupt break into the Skwentna, the slopes averaging from 5 to 25 degrees. The work over this section will range from 15,000 to 35,000 cubic yards per mile, averaging about 28,000 cubic yards, of which about 15 per cent will be in solid rock.

HAPPY RIVER VALLEY TO HOUSTON PASS.

Happy River is a rapid, clear-water stream from 1 to 6 feet deep and at its mouth about 250 feet wide. Heading in the mountains near Houston Pass, it flows northeast through a broad, deeply cut valley. Near the mouth of Pass Creek the river swings to the east and commences cutting through the underlying rock. At the mouth of Moose Creek it turns southeast and flows through

a narrow canyon which, gradually deepening, has a depth near the mouth of the river of about 250 feet. One mile above its mouth the river turns abruptly to the south and flows into the Skwentna River. The cost of any line through this canyon would be prohibitive.

Two alternative lines up the Happy River Valley are available, both following the higher benches on either side of the river. The one along the north side of the valley will, I believe, be found to be the most suitable as it will avoid the long, high crossing over Happy River Canyon near its mouth, which I estimated would be about 1,000 feet long and 250 feet high, and will, with its south exposure, be over drier ground. The one along the north side of the valley will require high crossings over Moose and Distin Creeks and across three deep gulches and two minor ones. Viaduct crossings of the three larger gulches will, I estimate, average about 380 feet in length and be about 150 feet high, and over the two smaller gulches about 300 feet in length and 100 feet high. The crossing of Moose Creek will be about 600 feet long and 50 feet high, that across Distin Creek about 500 feet long and 60 feet high. A line along the south side of the valley would require high crossings over four deep gulches besides the long crossing over Happy River Canyon. Aside from the high gulch crossings the work on both sides would average about the same. To the mouth of Moose Creek this, I estimate, will run about 28,000 cubic yards per mile, of which about 20 per cent will be in solid rock. Although the line along the north side of the valley had to be studied from a distance of from one-half to 1 mile, these estimates will, I think, be found to be approximately correct. The loss in distance over this section should not exceed 6 per cent.

From the mouth of Moose Creek to Houston Pass (pl. 75), a distance of about 17½ miles, the line will be over fairly uniform and rolling slopes of from 3 to 20 degrees. The work of construction over this section will be light, running from 12,000 to 16,000 yards per mile, of which about 15 per cent will be solid rock. As this section is out of timber, snow fences will be required to divert the drifting snow. This condition prevails for about 8 miles beyond Houston Pass, or a total of 24 miles of the line which is out of timber.

MOOSE PASS TO MOUTH OF TATINA RIVER.

From Moose Pass down the Ptarmigan Valley for a distance of about 8 miles, and to where the line turns west along the South Fork of the Kuskokwim, the work will be light, over fairly uniform and rolling slopes of from 3 to 5 degrees and will not average over 14,000 cubic yards per mile. Through the canyon of the South Fork of the Kuskokwim it will, I believe, be found advisable to hold the line along the north side on about the 2,280-foot contour, which is very close to timber line. Heavy work will be encountered over this section, running from 30,000 to 80,000 cubic yards per mile, 30 to 80 per cent of which will be solid rock. Turning north into the main valley of the South Fork of the Kuskokwim a fairly uniform slope of from 20 to 30 degrees will be available for supporting down to the river. No difficulty should be encountered here from slide rock, the formation being different from that encountered in Simpson, Rainy, and Teocalli Passes. At about mile 154 a gulch will have to be crossed which will probably require a crossing about 75 feet high. The line will follow the right or northeast bank of the South Fork of the Kuskokwim to the vicinity of mile 174, from which locality the left bank will probably furnish the lighter and better line. No definite point for a crossing was selected, as its approximate location could not be determined until after the return from Houston Pass or until we had reached Farewell Mountain, where the line leaves the valley of the South Fork of the Kuskokwim, when no time was available for further study.

This river is a swift, glacial stream, with a total width of about 350 feet and with a flood plain of from 350 to 1,500 feet wide. Near the mouth of the Tatina River, where this river was crossed on the reconnoissance, practically all of the water was in one channel about 300 feet wide. From mile 150 to mile 157 a line will run from 35,000 to 70,000 cubic yards of excavation per mile, probably averaging about 42,000 cubic yards, of which about 30 per cent will be solid rock. Down the valley of the South Fork of the Kuskokwim to the mouth of the Tatina River heavy work will be encountered for short stretches, but the average should not exceed 30,000 cubic yards per mile, of which about 15 per cent will be solid rock.

A. LOOKING UP HAPPY RIVER VALLEY.

B. LOOKING NORTH UP PTARMIGAN VALLEY; HOUSTON PASS EXTREME LEFT IN DISTANCE.

A. HOUSTON PASS.

B. PITKA FORK OF BIG RIVER.

MOUTH OF TATINA TO FAREWELL MOUNTAIN.

From the mouth of the Tatina River to Farewell Mountain the left bank of the river will, I believe, furnish the better line, with lighter work than would be encountered on the right bank. The ground is apparently dry, an exceptional condition for a northern exposure in Alaska. Post River, which will be crossed near its mouth, is a minor glacial stream about 300 feet in width, with a flood plain of about 1,000 feet wide. The greater portion of this can, I believe, be safely crossed with pile trestle. In my estimates I have provided for two spans of 66 feet in length. If the river is found to carry much drift, a greater length of opening will have to be left, in which case a more economical crossing may be found about half a mile upstream, where the river breaks through a narrow opening with rock banks.

Heavy work will be encountered for short distances both above and below Post River for a total distance of about 9 miles that will average for the entire distance, I have estimated, about 40,000 cubic yards per mile, fully 50 per cent of which will be loose and solid rock. The remaining 2½ miles at the south end and 6 miles at the north end of this section will be through dry-spruce river bottom, where the line will average about a 3-foot fill.

FAREWELL MOUNTAIN TO KUSKOKWIM RIVER.

From the valley of the south fork of the Kuskokwim River, near Farewell Mountain, to the summit of the Pitka Divide, the line will be over a gently rolling slope sparsely timbered, the total rise being only about 150 feet. Marshy stretches will be encountered over this section for short distances, but they should not cause serious trouble or heavy cost of handling. The Pitka Divide is a long, low range of hills extending northwesterly from the foothills of the Terra Cotta Mountains and paralleled by the South Fork of the Kuskokwim on the east. This range of hills evidently marks the lateral or terminal moraine of a glacier that at one time occupied the valley of the South Fork of the Kuskokwim. The top is irregular, with slight depressions and ridges, typical of glacier potholes, west of the Divide, and at an elevation of about 100 feet below the summit is a gravel flat or terrane, about 4 miles in width, evidently an old glacial plain. This flat is covered with reindeer moss and a young growth of scrubby spruce. From the South Fork of the Kuskokwim to this flat on the west side of the Pitka Divide the line will average from 20,000 to 25,000 cubic yards of excavation per mile. No exposures of solid rock were noted in this section. The excavation will probably be of loose and frozen material. Crossing the gravel flat the work will be exceedingly light, averaging about a 3-foot fill, side borrow being available for the entire distance. The flat at its western limit gradually merges into marshy tundra, which surround low, detached, and birch-covered hills and ridges. This conditions prevails throughout the basin of Big River and its tributaries, the only exception being the narrow belts of drained land along the banks of the forks of this river and along the minor creeks. The Pitka, Middle, and West Forks of Big River are all deep, sluggish streams, with an average velocity of about 2 second-feet. Pitka Fork will average about 230 feet wide, the Middle Fork about 330 feet, and the South Fork about 430 feet. These streams evidently drain an area of considerable extent, the greater portion of which, judging from the water, must be marshy. The reconnaissance through this region was along a line from 1 to 7½ miles north of a direct line to McGrath and the mouth of the Takotna River. This was due to the position of McGrath being incorrectly shown on all existing maps. From the general nature of the country and from what we could see from the low ridges the conditions over a direct line to the Kuskokwim Crossing would be very similar to the section over which we crossed. A more direct line will result in an increase of rise and fall, but by keeping on the ridges as much as possible drier ground will be secured. Through the valleys of the forks of the Big River and its adjacent marshes a fill of about 3 to 5 feet will be necessary. This material will all have to be long-haul borrow, either from the drained land adjacent to the rivers or from the low birch ridges. The drained land along the bank of the rivers is covered with a heavy growth of spruce, ranging in size from 8 to 24 inches, which will be of value both for ties and piling. In the marshy areas the timber is a small scrubby growth of spruce. Across the Big River Basin the loss in distance should not exceed 5 per cent.

THE KUSKOKWIM CROSSING.

In the vicinity of McGrath, at the mouth of the Takotna River and Kuskokwim River, is from 1,000 to 1,500 feet wide, with a current velocity of about 4 second-feet. The most suitable crossing disclosed by our hurried examination was at a point about 2 miles above the mouth of the Takotna, and at the end of a birch-covered ridge which forms the right bank of the river for some distance above. The left bank is alluvial and about 10 feet high. At this point the river is about 950 feet wide. This crossing is about 440 miles above the mouth of the river, which is navigable for river steamers to points on both the North and South Forks, about 20 miles above their junction, approximately 100 miles above the crossing.

NORTHWEST EXTENSION.

The natural extension of this route northwesterly, and the most direct, will lead up the lower Takotna Valley, a distance of about 13 miles, thence across the Takotna-Innoko Divide, into the headwaters of the Innoko River. The valley of this river furnishes a direct route northwesterly to Mount Hurst, where it turns to the north. Circling the northwesterly foothills of Mount Hurst the more direct line would cross the Dishna and Innoko Valleys, thence up the Kluklaklatna Valley, and across the Kaiyuh Mountains through a low gap near the head of Kluklaklatna Creek. The Yukon River would be crossed in the vicinity of Kan tag, whence the line would probably swing southwesterly to a crossing of Brocks Divide, thence northwesterly around the shore of Norton Bay, and by the Koyuk Valley into the Seward Peninsula. This line would pass through the Innoko mining district. The Ruby mining district would probably be reached by a line up the North Fork of the Innoko—the Iditarod District, by way of the Takotna, Moore Creek, and Bonanza Creek Valleys. The extension of this route along the line outlined will provide not only a direct and natural route, but will also make available easier and more direct connections with the adjacent districts. This country can all be described as rolling and of low relief, broad level valley separated by low ranges of mountains with rolling slopes—conditions which present no engineering difficulties to the construction of a railroad.

KUSKOKWIM RIVER TO INNOKO-IDITAROD JUNCTION.

From the crossing of the Kuskokwim River the line will follow along the foot of the ridge for about a mile and a half, where it swings up the Takotna Valley. Two routes up the lower portion of this valley will have to be considered, the first following the right side of the valley the entire distance and crossing the Tuentna, a tributary of the Takotna flowing from the northeast. This line will be about 3 miles longer than the more direct line across the lower portion of the Takotna Valley, but it will provide easy access or connection for any branch line up the Tuentna. There has been no development to speak of in this section, but as this is in a gold-bearing region and the valley one of considerable extent future development may render such a line advisable.

The Takotna is navigable for medium-sized river boats to the mouth of the Tuentna, a distance of about 16 miles by river and about 5½ miles in a direct line. Above this junction the Takotna is navigable only for the very shallow draft stern-wheel launches which traverse the river, except at low stages of water, to the mouth of Big Creek. Up the Lower Takotna Valley the line will average from a 3 to 5 foot fill through a level river valley, which is swampy, except for the narrow belts of drained land paralleling the river banks.

INNOKO EXTENSION.

Separating the waters of the Takotna from the Innoko is a range of low rolling hills from 900 to 2,000 feet in elevation above the Takotna Valley. Northwest of the settlement of Takotna and distant about 3½ miles are two gaps in this range approximately 3 miles apart and at an elevation of about 875 feet above the Takotna River. Either one of these gaps provides a practical route for reaching the waters of the Innoko, but it appeared probable that the north gap would furnish the shortest and easiest connection. The existence of a lower gap to the northeast appeared possible, and renders advisable a reconnaissance

of this region. To reach the northeast gap, east of Takotna, a supported grade line would leave the Takotna Valley at a point about 8 miles northeast of Takotna. Such a line would probably average about 32,000 cubic yards of excavation per mile. The slopes are rolling and range from about 10° to 30°.

IDITAROD EXTENSION.

The valleys of the Takotna River, Moore Creek, and Bonanza Creek furnish an easy and almost direct route to the Iditarod district. The divides between these creeks are low and easy of approach. Loss of distance will, however, be encountered in supporting down on the southwest slopes of each divide. From the Innoko Junction, mile 282, to Takotna, mile 290, the line will average from a 3 to 5 foot fill in the valley of the Takotna.

From Takotna to the bend of the Takotna River at mile 295 a line along the left bank of the river will be along the foot of the steep rocky slope which, for the last 2½ miles, will entail heavy work, the slope averaging about 30°. The rock is a shale and easily handled. A line along the right bank over this section will avoid the heavy work encountered along the left bank, but such a line will necessitate two crossings of the Takotna River. Should the direct alternative route from McGrath to Innoko Junction be adopted, one of these crossings could be avoided by following the right bank of the river and east side of the valley. This line would skirt the base of Porcupine Bluff for about 1,000 feet. The bluff is a gravel bank about 75 feet high with a slope of about 35°, and would furnish material for the fill across the valley. From the bend in the Takotna River at mile 295 to the foot of the ascent to Moore Creek Divide, mile 331, the line is up the level and gently undulating valley of the Takotna. Over this section the work of construction will be light, averaging about a 3-foot fill. Throughout the valley of the Takotna the drained land close to the rivers and creeks and on the low ridges is timbered with spruce of a good quality that will furnish all timber required for piles and ties.

The ascent of about 150 feet from the valley of the Takotna to the Moore Creek Divide can be easily overcome with light work on a 2 per cent grade.

MOORE CREEK DIVIDE TO BONANZA CREEK DIVIDE.

[Map sheet 40.]

From the summit of the Moore Creek Divide there will be a drop of about 370 feet in the valley of the North Fork of Moore Creek. The slopes on the west side of this valley are light, averaging about 4° or 5°, and no difficulty should be experienced in securing a location with light work on a 2 per cent supported grade. A distance of approximately 1 mile will have to be developed in this section. This can, I believe, be secured in the large lateral creek valley north of the Moore Creek Road House at mile 338. From the latter point to the Bonanza Creek Divide, mile 345, there is an ascent of about 525 feet. This should be overcome on a 2 per cent grade without heavy work. A tunnel from 2,300 to 2,800 feet in length through this divide would decrease the grade summit from 125 to 200 feet. The valleys of both forks of Moore Creek are timbered with spruce of a good quality.

A possible alternative that would avoid the Takotna-Moore Divide would be by way of Moore Creek, which, I was advised, flows into the Takotna above the mouth of Big River.

BONANZA CREEK DIVIDE TO IDITAROD.

The town of Iditarod is situated at practically the head of navigation on the Iditarod River. This stream is navigable to Iditarod for only the lightest draft launches and barges, except during the spring freshet, when the larger draft boats can ascend to this point. The terminus of the latter during ordinary stage of water is at Dikeman, about 30 miles north of Iditarod. The greater extent of the mining operations in the Iditarod district are now located in the valley of Otter Creek, which empties into the Iditarod River about 9 miles above and south of Iditarod.

Flat City, a distributing center for the district, is situated in the Otter Creek Valley, about 7 miles above its mouth. A wagon road and a wooden-rail tramroad connect Flat City and Iditarod. These roads are both about 7 miles long and their route is a direct one across the ridge. Otter Creek heads on the

west side of Camelback Mountain and flows southwest, parallel to Bonanza Creek, which heads on the south side of the mountain. Between these creeks is a ridge of rolling hills from about 600 to 1,200 feet above the creek valleys. The more direct route from the Bonanza Creek divide to the center of the Iditarod district at Flat City would be across this ridge near its head. Time would not permit of an investigation of this route, which I believe to be a possible one. It is probable that the ridge where crossed by such a line will be at an elevation probably 200 to 300 feet higher than the Bonanza Creek divide and that a considerable distance will have to be developed in supporting down into the Otter Creek Valley. But, allowing for this extra developed distance and loss of grade, such a route to Flat City, if practicable, should be at least 20 to 25 miles shorter than by the way of the mouth of the Bonanza Creek.

BONANZA CREEK ROUTE.

In the first 2½ miles down Bonanza Creek from the divide at its head there is a drop of about 625 feet. This will necessitate the development of between 4 and 5 miles of extra distance. The slope on the west side of the creek is the flattest and more uniform, averaging only about 6 degrees. About 2½ miles below the summit a large creek enters Bonanza from the northwest, flowing from a deep-cut basin that may furnish the slopes to support a line for the required distance without resorting to switchbacks. About 2 miles below the summit is a second and larger creek flowing into the Bonanza from the northeast that should furnish slopes for this distance, but where, I believe, heavier and more costly work will be encountered than on the west side, the west slope being most favorable to light work. Not having the time to make the necessary examinations of these creek valleys or of the route across the divide into Otter Creek, I continued down Bonanza Creek Valley, and have based my estimates of cost for this distance of supported grade into the valley of Bonanza Creek on an estimated cost of a switchback line over this slope. Down the valley of Bonanza Creek the work of construction will be light, averaging a 3 to 4 foot fill, probably 60 per cent of the line being over marshy tundra. A line through the valleys of Otter Creek and the Iditarod River will average about the same as in the valley of Bonanza Creek.

Another possible alternative route, across the ridge between Bonanza and Otter Creeks to Flat City, would leave the Bonanza Creek Valley at about mile 360 and cross the ridge through the gap occupied by the winter trail. This line would be about 15 miles shorter than by the way of Bonanza Creek, but will be more expensive both to construct and maintain than the valley line, about 18 miles being supported grade over rolling, rocky slopes ranging from 10 to 35 degrees. The ascent from Bonanza Creek Valley is about 550 feet and the descent to Flat City about 850 feet. An approximate comparative estimate of the cost of these two lines with a consideration of the extra distance is in favor of the longer valley route.

If the only objective of these lines was the present centers of activity the consideration of the alternative lines would be greatly simplified, but with the large adjacent undeveloped territory, the possibilities of which are practically unknown, a proper location necessitates a study of the adjacent regions so as to provide for the branch-line connections that will develop the greatest area.

CONSTRUCTION MATERIAL.

Borrow.—Over the greater portion of the valley sections and over a considerable portion of the bench sections of these lines the material for the required fill of from 3 to 5 feet will have to be brought from the low ridges and hills, where good material of river and glacial deposited sand and gravel is available. This long haul will, in portions of the Yentna, Big River, and Takotna Valleys, be fully 7 miles in length.

Riprap.—Rock suitable for riprap will be scarce. The only exposures of suitable material noted in close proximity to the line was an outcrop of granite in the Shell Hills and outcrops of intrusives along the Kuskokwim and the South Fork of the Kuskokwim.

Timber.—As compared with other sections of interior Alaska, the region traversed is well timbered with spruce, birch, cottonwood, poplar, and aspen. In the lower valley level the spruce is of good quality and ranges from 8 to 22 inches in diameter, many trees of the latter size being noted. The largest

A. POTATO PATCH AT McGRATH, KUSKOKWIM RIVER.

B. KUSKOKWIM RIVER AT McGRATH.

A. BONANZA CREEK VALLEY.

B. NATIVE HAYFIELD ON HILLSIDE FROM WHICH TIMBER HAS BEEN CUT, NEAR FLAT CITY, IDITAROD DISTRICT.

spruce observed was in the valley of the South Fork of Moore Creek, at an elevation of about 1,300 feet above sea level, where a spruce 36 inches in diameter was noted. In this valley there was probably the heaviest stand of timber observed anywhere along the line, but the trees were not as tall, straight, and free from limbs as in the lower valleys. The birch ranged in diameter up to 26 inches. Spruce in suitable lengths for piling can be secured throughout the valleys and bench sections of the line. Spruce suitable for tie timber is available throughout the region covered, except where the location will be above timber line and across the swampy stretches, upon which there is only a scattering growth of young, scrubby timber.

GRADES AND CURVATURES.

Estimates are based on a maximum grade of 2 per cent and a maximum curvature of 12 per cent. The country is such that both grade and curvature can be reduced without heavy cost when traffic warrants.

Rivers and creek crossings, with proposed type of structure on which estimates are based.

	Feet.	Feet.
Susitna River:		
No. 1—6 121-foot through Howe truss spans	750	
15 14-foot pile trestle spans	210	
		960
No. 2—1 66-foot through Howe truss span	70	
12 14-foot pile trestle spans	168	
		238
No. 3—1 121-foot through Howe truss span	125	
2 99-foot through Howe truss spans	208	
5 14-foot pile trestle spans	70	
		403
Trestle between above crossings, 124 14-foot pile trestle spans		1,736
Kroto River, 20 14-foot pile trestle spans		280
Kahiltna River:		
3 121-foot through Howe truss spans	375	
7 14-foot pile trestle spans	98	
		473
Lake Creek:		
1 66-foot through Howe truss span	70	
10 14-foot pile trestle spans	140	
		210
Yentna River:		
No. 1—1 121-foot through Howe truss span	125	
30 14-foot pile trestle spans	420	
		545
No. 2—3 121-foot through Howe truss spans	375	
9 14-foot pile trestle spans	126	
		501
Happy River Gulches assumed to be—3 averaging 335 feet long, 150 feet high; 2 averaging 280 feet long, 100 feet high:		
3 steel viaducts—each, 1 155-foot span, 155 feet; 2 60-foot spans, 120 feet; 2 30-foot spans, 60 feet=335 by 3		1,005
2 steel viaducts—each, 1 100-foot span, 100 feet; 2 60-foot spans, 120 feet; 2 30-foot spans, 60 feet=280 by 2		560
Distin Creek:		
1 66-foot Howe truss deck span	70	
31 14-foot spans frame trestle on piles	434	
		504
Moose Creek:		
1 66-foot Howe truss deck span	70	
38 14-foot spans frame trestle on piles	532	
		602
Gulch South Fork Kuskokwim, near canyon:		
1 88-foot Howe truss deck span	93	
64 14-foot spans frame trestle on piles	896	
		989

	Feet.	Feet.
South Fork Kuskokwim:		
1 121-foot through Howe truss span	125	
2 99-foot through Howe truss spans	208	
3 14-foot pile trestle spans	42	
		375
Post River:		
2 66-foot through Howe truss spans	140	
69 14-foot pile trestle spans	966	
		1,106
Pitka Fork Big River:		
2 99-foot through Howe truss spans	208	
4 14-foot pile trestle spans	56	
		264
Middle Fork Big River:		
3 99-foot through Howe truss spans	312	
4 14-foot pile trestle spans	56	
		368
West Fork Big River:		
4 99-foot through Howe truss spans	416	
4 14-foot pile trestle spans	56	
		472
Kuskokwim River:		
1 225-foot through steel lift span	229	
3 225-foot through steel spans	687	
3 14-foot pile trestle spans	42	
		958
Tuentna River:		
2 99-foot through Howe truss spans	208	
4 14-foot pile trestle spans	56	
		264
Total		12,813

Through steel lift span	229
Through steel spans	687
Viaduct steel spans	1,565
Through Howe truss spans	3,715
Howe truss deck spans	233
Frame trestle spans	1,862
Pile trestle spans	4,522
Total	12,813

The width of the crossings over the south fork of the Kuskokwim and the Pitka, Middle, and West Forks of Big River were assumed to be the same as where these rivers were crossed on the reconnaissance.

Estimate of cost.

From junction with Susitna-Fairbanks line at station 115, Millikens division, Susitna Valley to McGrath Junction, 1⅞ miles east of McGrath, Kuskokwim Valley, via route to north of Shell Hills and through Houston Pass (length, estimated, 269 miles):		
Clearing, 200 feet wide, 3,228 acres, at $75		$242,100
Grubbing, 242 acres, at $100		24,200
Excavation—		
Earth, 2,030,000 yards, at 40 cents		812,000
Borrow, long haul, 900,000 yards, at 75 cents		675,000
Frozen material, 1,420,000 yards, at 90 cents		1,278,000
Loose rock, 950,000 yards, at 75 cents		712,500
Solid rock, 1,120,000 yards, at $1.50		1,680,000
Pile trestle, over swamps, river bars, and creeks, estimated 8,000 feet, at $12 per foot		96,000
Wooden bridges and pile-trestle approaches—		
Piles, 179,140 linear feet, at 30 cents	$53,742	
Lumber, 5,201,720 feet b. m., at $40 M	208,069	
Iron, 2,283,236 pounds, at 8 cents	182,659	
Riprap, 7,180 cubic yards, at 4 cents	28,720	
		473,190

Steel structures, Kuskokwim Bridge and Happy Valley viaducts—		
Piles, 44,600 linear feet, at 30 cents	$13,380	
Sheet piling, 789,000 feet b. m., at $50 M	39,450	
Lumber, 253,100 feet b. m., at $40 M	10,204	
Iron, 16,400 pounds, at 8 cents	1,312	
Excavation—		
12,000 cubic yards, at $2	24,000	
8,100 cubic yards, at $7	56,700	
Concrete, 12,330 cubic yards, at $12	147,960	
Steel, 7,502,700 pounds, at 8 cents	600,216	
Riprap, 2,200 cubic yards, at $4	8,800	
		$902,022
Culverts, timber, 807, at $122 each		98,454
Track, including laying and surfacing, 269 miles, at $12,035 per mile		3,237,415
Sidings, including excavation and all material, 11 miles, at $16,200		178,200
Water supply, estimated per mile, at $195; telephone, estimated per mile, at $340; bunkers, section houses, station buildings, estimated per mile, at $350		238,065
Snow fences, estimated at 60,000 feet, at 34 cents per linear foot		20,400
Engineering, superintendence, and contingencies, 10 per cent		1,066,755
Total cost		11,734,301
Average cost per mile, $43,622.		
McGrath Junction to Innoko-Iditarod Junction, via Tuentna River (length, estimated, 13 miles):		
Clearing, 200 feet wide, 152 acres, at $75		11,400
Excavation—		
Earth, 118,000 cubic yards, at 40 cents		47,200
Borrow, long haul, 100,000 cubic yards, at 75 cents		75,000
Bridges and pile trestles		30,000
Culverts, timber, 36, at $122		4,392
Track, including laying and surfacing, 13 miles, at $12,035 per mile		156,455
Sidings, 0.5 mile, at $16,200 per mile		8,100
Water supply, telephone, and buildings, at $885 per mile		11,505
Engineering, superintendence, contingencies, 10 per cent		34,405
Total cost		378,457
Average cost per mile, $29,112.		
Innoko-Iditarod Junction to Ophir-Innoko-Iditarod Junction to Innoko Divide (length, estimated, 11 miles):		
Clearing, 200 feet wide, 131 acres, at $75		9,825
Grubbing, 10 acres, at $100		1,000
Excavation—		
Earth, 100,000 cubic yards, at 40 cents		40,000
Frozen material, 120,000 cubic yards, at 90 cents		108,000
Loose rock, 60,000 cubic yards, at 75 cents		45,000
Solid rock, 70,000 cubic yards, at $1.50		105,000
Culverts, timber, 33 at $122 each		4,026
Track, including laying and surfacing, at $12,035 per mile		132,385
Sidings, 0.4 mile, at $16,200 per mile		6,480
Water supply, telephone, and buildings, at $885 per mile		9,735
Engineering, superintendence, and contingencies, 10 per cent		46,145
Total		507,596
Average cost per mile, $46,145.		
Innoko Divide to Ophir:		
Estimated at 16 miles, at $44,648 per mile		738,320
Total cost		1,245,916
Total distance, 27 miles.		

Innoko-Iditarod Junction to Flat City, center of Iditarod placer district via mouth of Bonanza Creek (length, estimated, 114 miles):	
Clearing, 200 feet wide, 1,368 acres, at $75	$102,600
Grubbing, 100 acres, at $100	10,000
Excavation—	
Earth, 450,000 cubic yards, at 40 cents	180,000
Borrow, long haul, 450,000 cubic yards, at 75 cents	337,500
Frozen material, 660,000 cubic yards, at 90 cents	594,000
Loose rock, 450,000 cubic yards, at 75 cents	337,500
Solid rock, 350,000 cubic yards, at $1.50	525,000
Pile trestle, estimated at 4,800 feet, at $12 per foot	57,600
Culverts, 228 at $122 each	27,816
Track, including laying and surfacing at $12,035 per mile	1,371,990
Sidings, 5.2 miles at $16,200 per mile	84,240
Water supply, telephone, and buildings, at $885 per mile	100,890
Engineering, superintendence, and contingencies, 10 per cent	372,913
Total	4,102,049
Average cost per mile	35,982

SUMMARY.

	Miles.	Amount.
From—		
Junction with Susitna-Tanana line to McGrath Junction	269	$11,734,301
McGrath Junction to Innoko-Iditarod Junction	13	378,457
Innoko-Iditarod Junction to Ophir	27	1,245,916
Innoko-Iditarod Junction to Flat City	114	4,102,049
Flat City Junction to Iditarod	10	330,000
Total	433	17,790,723
Average cost per mile		41,087

The above estimates are based on construction from lower terminal only, with a freight cost, to front of approximately 1 cent per ton-mile. Construction along this route can be pushed from the following points, reached by water transportation:

Susitna and Yentna River crossings for shallow-draft boats with light loads.

Kuskokwim River crossings for large river boats.

Tuentna and Big River crossings, for shallow-draft boats with light loads.

Iditarod terminal for shallow-draft boats with light loads, except during spring freshets, when larger-sized river boats can reach this point.

Should a consideration of the factors of time and development of country and traffic result in attacking the work from a number of bases, as would appear probable, it will result in an increase of cost of construction over the above estimates, equal to the cost of the river and small-boat transportation and extra handling of material and supplies.

PRELIMINARY SURVEYS AND RECONNOISSANCE OF ALTERNATIVE ROUTES.

The preliminary survey of the Kuskokwim route as far as Ophir in the Innoko district, with a line via the Tacotna Valley to Flat City and Iditarod, will require the services of four field parties for one season.

Working in conjunction with the parties on preliminary survey should be two small parties of three or four each engaged on reconnoissance for detail of the alternative routes, the extension through the Innoko region to the Lower Yukon, and on the extension into the Ruby district. This work should be commenced in the late winter or early spring, when the swampy areas can be covered much more easily and economically than at any other season of the year, and so that the data relative to the alternative route through the Shell Hills in the Yentna Valley, and through the Big River and Kuskokwim Basin may be secured before these sections are reached by preliminary survey.

As the successful development of this route will require a study and knowledge of all the region tributary to it, and as the parties engaged on this work

will be away from all direct means of communication, I would recommend that the direction of these surveys be placed under the direct supervision of a division engineer. This will result in coordination of work and results that can not, I believe, be secured in any other way.

Light gasoline launches should be available for this work in both the Sustina and Kuskokwim Basins. This item of cost I have included in my estimate of the cost of this work, which will be approximately $100,000 for all of the above preliminary and reconnoissance surveys.

RESOURCES.

The present available information relative to the resources of the region adjacent or tributary to the Kuskokwim route is summarized as follows:

Mineral.

Yentna district.—From Bulletin 534 of the United States Geological Survey, by Stephen R. Capps, who examined the Yentna district in 1912, it is shown that placer mining has been conducted in the region tributary to the Kahiltna Valley since 1905, and that the output up to and including 1911 totaled $383,000. In the opinion of Mr. Capps:

"These figures should be encouraging if the lack of transportation and the freight charge of from 10 to 15 cents a pound for all supplies and equipment brought to the mines are considered. Should a railroad penetrate the Susitna Valley and reduce the time and expense of landing supplies at the camps much ground which is not now worked could be mined at a profit, and the gold output of the region would be greatly increased.

"It is reported that fine gold has been found on the Kichatna and its tributary, the Nakochna, which lie between the Yentna and the Skwentna Rivers, and that these streams afford extensive areas of gold-bearing gravels suitable for dredging."

Although Mr. Capps refers to no lode deposits in this region known up to 1912, the writer was shown rich gold-bearing quartz at Susitna Station this summer which, it was stated, had been found the year previous in this section.

Skwentna and South Fork of Kuskokwim.—These section were traversed in part in 1898 by Josiah E. Spurr for the United States Geological Survey, whose report is embraced in the Twentieth Annual Report of the Survey, part 7. Mr. Spurr reports finding colors of gold in the bar gravels on the Yentna River, a few miles above the Susitna, on the bars of the Skwentna, near the mouth of Hayes River, "where the grains were of considerable size; nearly large enough to be called coarse gold," and on the bars in the second canyon of the Skwentna. After explaining the origin of this gold Mr. Spurr states that "it is likely that this Eocene mineralization has been sufficient to bring about ore deposits which would pay for working if conditions of supply and transportation were sufficiently favorable." Mr. Spurr noted on the Kuskokwim, below the Styx River, that "that gravels which form the Pleistocene bluffs show many colors of gold."

Colors of gold half the size of a pinhead were found by the writer in the gravel bars of the lower Teocalli Creek, Kuskokwim.

Kuskokwim.—Although numerous discoveries of gold have been reported in the Kuskokwim Basin, it is only during the last year that there has been a production of any size in the central region. Candle Creek, situated about 7 miles southwest of McGrath, will this year produce about $70,000. Gold was first discovered on this creek in 1912.

Innoko district.—Gold was first discovered in the Innoko district in 1906. Placer mining is now being conducted on some seven different creeks. The annual production from this district is approximately $250,000, and the total output to date about $1,750,000.

Iditarod region.—Gold was first discovered in the Iditarod district on Christmas Day, 1908. In 1910 the production was about $500,000, and during the year 1914 approximately $2,500,000. The total production of the camp to date is estimated at about $10,400,000.

Ruby district.—Gold was first discovered in the Ruby district late in 1907. In 1913 some 41 plants were engaged in mining, operating on 14 creeks and employing about 230 men. The total production, including the year 1914, is estimated to be in excess of $2,000,000.

Seward Peninsula and Northwestern Alaska.—The northwestern portion of Alaska embracing the Seward Peninsula has produced placer gold to the value of about $70,000,000, the investigation of the United States Geological Survey going to show that this peninsula has a greater amount of gold-bearing gravel than contained in the entire State of California.

Gold-bearing quartz has been discovered in the Innoko district and in numerous localities throughout the Seward Peninsula. Copper-bearing lodes have been reported from the Kobuk region, and a number of limonite-hemitite deposits have been located about 25 miles northwest of Nome. The extent and value of these deposits is unknown, as little development work has been done. It is only with improved transportation facilities and the resulting reduction in cost of labor and supplies that such properties can be economically developed.

Coal.

An outcrop of lignite was noted on the north bank of the Skwentna River, about 2 miles above the mouth of Hayes River (map sheet 10). The bed is dipping to the north on an angle of about 10°, and is overlaid with fine-grained shale. The river has exposed the width of the bed to a depth of 15 feet. Lignite is known to exist in the Yentna, Iditarod, and Unalaska regions. Along the west bank of the Yukon River, in the vicinity of Kaltag, are extensive areas known to contain low-grade bituminous coal.

[U. S. Geological Survey, advance report for 1914.]

The following relating to the above districts is from the advance statement of the United States Geological Survey on "Mining in Alaska in 1914," dated January 1, 1915:

"Operations in the Yentna placer district were conducted on about the same scale as in previous years. Some test drilling of prospective dredging ground was done. Work is also being done on some lode prospects in this district.

"*Kuskokwim Basin.*—According to report of A. G. Maddren, of the Geological Survey, placer gold mining and prospecting were conducted at nine widely separated localities of more or less importance in the Kuskokwim Basin during 1914, marking a zone extending from the Takotna Basin to Kuskokwim, a direct distance of about 400 miles. A little gold-bearing beach sand has also been reported on the coast of Bering Sea, about midway between Togiak Bay and Cape Newenham.

"The most important mining developments in this zone during 1914 were on Candle and Moore Creeks, tributary to upper Takotna River. On both these creeks systematic prospecting by drilling and sinking of shafts was carried on and satisfactory results are reported. Productive mining was also carried on in this field, a total of about 35 men being engaged in mining and development work. Mining was also done in the headwater region of Crooked Creek, tributary to the Kuskokwim near Georgetown. Mining was also continued on Bear Creek and some of its tributaries in the Tuluksak Basin; on Canyon Creek, flowing into the Kwethluk River; on Marvel Creek, of the Aniak River Basin; on Rainy and Capon Creeks, confluents of Eck River; and on Butte Creek, a tributary of Aalalik River. All of these operations except those in the Tuluksak Basin are on a small scale. While auriferous gravels are widely distributed, but few rich placers have been found. The promise for the future of mining in most of this field seems to lie in exploitation of the placers on a large scale.

"Lodes, including deposits carrying gold, copper, and cinnabar, have attracted some attention in the Kuskokwim Basin in spite of the present difficulties of transportation. There has been a small production of quicksilver from the Parks claims, a cinnabar prospect located on the north bank of the Kuskokwim, about 21 miles above Georgetown. Philip S. Smith, of the Geological Survey, who examined this deposit in 1914 reports it to include a commercial ore body. Other cinnabar deposits in this region have been more or less prospected.

"A copper deposit located in the Russian Mountains, about 18 miles northwest of Kolmakof, on the Kuskokwim, was examined in 1914 by A. G. Maddren, who reports that a 25-foot shaft has been sunk on a fissure vein, 30 to 60 inches in width, which has been traced some 4,000 feet. The ore contains chalcopyrite, mispickel, pyrite, and stibnite. It is reported by the owner that the ore contains gold, silver, and copper and a trace of nickel.

"*Innoko-Iditarod district.*—Abundance of water favored placer mining in the Iditarod and Innoko districts during 1914 and they yielded gold to the value of about $2,200,000. Two dredges were operated, one on Flat Creek and one on Otter Creek. Most of the other operations consisted of open cutwork, with the use of steam scrapers or bucket hoists. As in 1913, the principal mining was done on Flat and Otter Creeks, but plants were also operated on Happy, Moore, Willow, Chicken, Black, and other creeks of the district. In the Innoko district mining was done on Little, Colorado, Yankee, Ganes, Spaulding, Fox, Cripple, and other creeks.

"*Ruby district.*—The Ruby placer-gold district embraces an auriferous zone stretching for about 50 miles south from the Yukon and including part of the headwater basin of Innoko River. Preliminary estimates indicate that the gold output from this field in 1914 had a value of about $1,000,000 compared with $875,000 for the output of 1913.

"The most extensive mining in the district was done on Long Creek and its tributaries, where about 15 plants, some of considerable size, were operated. A new development is the finding of valuable deposits on the bench claims of Long Creek. There was also considerable mining of the placers on Poorman Creek and other streams in the vicinity. The output from this part of the field is estimated to have a value of $120,000, which was taken from about 17 claims. About 50 placer mines were worked in the entire Ruby district during 1914.

"*Seward Peninsula.*—Preliminary estimates indicate that the value of the placer gold produced in Seward Peninsula in 1914 was $2,700,000 compared with an output worth $2,500,000 in 1913. The gold production would have been larger had it not been for the fact that the mining season for dredges opened much later than usual. Forty-one gold dredges were operated on the peninsula for the whole or a part of the open season compared with 37 in 1913. Several other dredges are in process of construction. The average daily capacity of these dredges was about 41,800 cubic yards. There was an abundance of water during the summer and hence a larger number of small plants were operated than in the previous year. It is estimated that during the summer about 1,200 men were engaged in mining on the peninsula, of which 450 were employed on the dredges. A little winter mining (in 1913–14) was done in the Nome, Kougarok, and Fairhaven districts, but the winter output was only a small percentage of the total gold production.

"*Tin.*—The total production of Alaskan tin mined since the industry started in 1902 is about 550 tons of metallic tin, valued at $432,000. In 1914 one dredge was operated on the Buck Creek placer-tin deposits throughout the open season. Two others were operated for a part of the season on Anikovik River, working on deposits carrying both gold and tin. Operations were also continued and some tin was produced at the Lost River lode-tin mine. All these localities are in Seward Peninsula.

"Except for the development of the Lost River tin mine, there was but little activity in lode mining on the peninsula in 1914. It is probable that not over 10 or 15 men were engaged in gold-lode development, and those were doing chiefly assessment work.

"*Kobuk region.*—Placer mining in a small way was continued in the Kobuk region during 1914. In the Squirrel River district three claims were worked in the winter and five in the summer, giving employment to 12 to 20 men. Some mining was also done in the Shungak district. The total output of gold from the Kobuk region in 1914 is estimated to have a value of about $50,000."

AGRICULTURE AND STOCK RAISING.

The valleys of the Susitna, Yentna, Skwentna, Kuskokwim, Innoko, and Lower Yukon Basins are all suitable to agricultural development in the raising of the hardier cereals and vegetables. There has been little development in these sections along these lines, due to lack of a market, which will only come with the development of the mineral resources.

Vegetables are raised at all of the settlements, at Susitna Station, McDougall, at the mouth of the Salmon River, at Berry Station, at the mouth of Big River, at McGrath, the Forks of the Takotna and Tuentna, and at Takotna. On the left bank of the Kuskokwim, opposite McGrath post office, D. W. Sprague has cleared about 2.5 acres of land, about 0.80 acre of which are devoted to the raising of potatoes. These he sells in the local mining camps, netting him about 10 cents a pound. His crop for this last year was in excess of 6 tons. The

writer was shown nine potatoes which averaged over a pound each, and which he was informed all came from one hill.

Throughout these valleys are immense areas of wild grass land. On the bare hillsides of the Skwentna Valley the growth is very heavy. This is all native redtop, and heights of 5 and 6 feet were noted. (Photos 62, 102, and 411.) The luxuriant growth of grass throughout the Yentna and Skwentna regions is commented on by Alfred H. Brooks, Stephen R. Capps, Joseph E. Spurr, and Lieut. Herron in their reports of this region. The writer has seen nowhere in the north country, or in fact in any section of the States, such a luxuriant growth of native grass.

About 2 miles northwest of Flat City, in the valley of Otter Creek, the timber was cut from the hill slope over quite an area. This slope is now covered with a heavy growth of redtop grass, and is being used by the freighters of this region as forage for their stock. In photos 529 and 532 the haycocks are visible in the distance. With the introduction of cattle, acclimated to northern conditions, these immense areas of grazing land should result ultimately in the building up of a meat and dairy industry of large proportions.

REINDEER INDUSTRY.

Up to 1902 we had imported from Siberia 1,280 head of reindeer. The herds are now estimated to total over 55,000 head. It has been estimated by those familiar with this industry that the immense areas of reindeer moss and native grass in Alaska will supply forage for many millions of these animals, the greater number of which now range over western and northwestern Alaska and in the tributary regions. This is an industry which promises big returns.

With the greatly increased development in the rich mineral resources of Alaska which will be brought about by improved transportation facilities, agriculture, dairying, and stock raising should prove profitable industries.

TONNAGE.

The tonnage in sight for the Kuskokwim route, built only as far as McGrath, can only be stated as the present tonnage now handled through McDougall and McGrath, which probably does not exceed 1,200 tons a year.

(Comment:) Tonnage estimates on such a basis have no meaning, as the country from Susitna to McGrath, in the Kuskokwim, is in practically the same condition, as far as development is concerned, as it was during the Russian régime, when fur was the sole output from this region. If the building of railroads through a new country awaited the development of sufficient tonnage to warrant their construction none would have been built, and our frontier would not now be Alaska. Tonnage is only developed through the facilities and economies afforded by improved transportation. Neither can we consider it only for the distance to McGrath now under consideration. It must be considered from the standpoint of the tributary sections that will be reached by extensions and branches.

In considering the value of undeveloped resources we must in part be governed by the reports of scientific investigators and a study of pioneer development under like conditions. It has been only during the last few years that even the most optimistic would concede that Alaska would be a land of a permanent and prosperous people, simply because as a people we were not used to such climatic conditions as obtain through the northland, and we had in nowise grasped the extent of her enormous undeveloped mineral wealth and natural resources. It was only after a study of what had been accomplished under like conditions of climate by the sturdy races of Europe and Asia, in countries that can in nowise compare with Alaska in mineral wealth or natural resources, that we realized the immense potentialities of our great northern Territory. A few comparisons will not, I think, be out of place. Norway, Sweden, and Finland, in the same latitude as Alaska and with very similar climatic conditions, have a combined area only two-thirds as great as that of Alaska. They support a population of about 10,900,000, as against approximately 65,000 for Alaska. These lands have no mineral wealth other than iron—no coal, not near the area of arable lands, nor the wealth of fisheries with which Alaska has been so lavishly endowed. A prominent Alaskan Swede, who has been over a great portion of the northland, recently said, when talking of the possibilities of Alaska: "If Norway and Sweden were one-half as rich in resources as Alaska none of us would have ever left there."

The remarkable development that has been going on in northern Canada during the last seven years is the result of improved transportation facilities. With this we are more or less familiar. But with the transformation that is taking place in northern Europe and Asia we are not so well acquainted. In the special consular reports, No. 61, Department of Commerce, Bureau of Domestic Commerce, entitled, "Russia, a Handbook on Commercial and Industrial Conditions," Consul John F. Jewell, of Vladivostok, refers to Siberia (p. 215) as "one of the most interesting of the new developing countries of the world." (P. 216:) "The Trans-Siberian Railway opened up a vast country, but its branches north and south, all of which are fed by a great river traffic, are opening up rich areas to colonization, trade, and civilization. In 1912 Siberia exported 77,642 short tons of butter, valued at $30,900,000." (P. 219:) "Industrial centers are developing where a decade ago were seen only collections of small houses. They are found where the railway crosses the principal waterways. Distilling, milling, skin curing, leather making, and such other industries as depend on cheap raw material are beginning, although, as compared with other countries, they are still in their infancy. There are towns of 20,000 to 50,000, and the population is steadily increasing." In referring to the Yakutsk Province (p. 224): "The Province being shut off by high mountains from the influence of southern winds, has the coldest climate of all populated countries. The roads are poor and the transportation of goods and traveling of its inhabitants is by water. Formerly the Province was regarded as unfit for agriculture, but recent investigations have proved otherwise. * * * In 1912 three expeditions of the (Russian) colonization department worked in the Province, investigating its capacity as a field for colonization, and their reports have established the fact that agriculture is not only possible, but can be carried on at a profit. The population of the Province is given as 274,442, and it is stated that wheat forms an important part of the diet of the population, including all of the natives. The period for ripening grain is 71 days for barley, 92 days for spring corn, 82 days for oats, and 76 days for wheat. Agricultural machinery has begun to find a small market in this Province."

"Animal raising represents one of the most important occupations of the inhabitants of the Province, especially the natives, many of whom are nomads. Owing to the severity of the winters, but mainly on account of bad methods of handling and feeding the animals, neither the number or quality is as it should be. In 1911 the number of animals was 486,816, divided as follows: Horses, 113,314; cattle, 333,851; sheep, 140; pigs, 638; deer, 37,283; sleigh dogs, 1,590."

Finland, with an area less than one-fourth the size of Alaska, had a population in 1909 of 3,059,324 (p. 203). The total value of her products for 1909 is shown to be $79,468,200, while that of Alaska for 1913 was $36,271,413, with a population of only 64,356. Finland has 2,444 miles of railway, of which 2,214 were built and are operated by the State. The gross receipts of the Government railways in 1912 were $10,317,780. The original cost of these roads amounted to $51,376,600 at the close of 1911, "whereas the enhanced capital cost," according to Mercator, "is estimated at not less than $79,728,300. Freight traffic showed a satisfactory increase in revenues, but the passenger traffic is inconsiderable." Imperial consent has been given for the construction of two new railways.

It is not, however, necessary to leave our own land or even to leave the soil of Alaska in order to judge of pioneer development as affected by transportation. The opening up and settlement of our west, with the growth of an enormous tonnage where none formerly existed, is a development of recent date and familiar to all.

In Alaska, despite its great handicap in the lack of transportation facilities, there has been a development that has been far-reaching and of the greatest value to the north—a development that has demonstrated to our people that the broad valleys of Alaska will furnish the greater part of the food for her people and that agriculture will prove profitable wherever a local market is to be had. With improved transportation facilities the development of her rich mineral deposits will furnish the markets and foster the agricultural development during its pioneer growth, and this development will assure a stable population.

Such conditions, with the great wealth in fisheries, coal, gold, copper, and other precious metals with which Alaska is so richly endowed, assure, under rational development, a prosperity that bespeaks a strong, contented people.

Appendix G.—STATEMENT OF AGRICULTURAL RESOURCES AT FAIRBANKS, ALASKA.

[Prepared by Fairbanks Commercial Club.]

Table of weights and valuations of produce grown in and around Fairbanks, Alaska, for the year 1914.

[Estimate made of information received from 45 bona fide ranchers.]

Produce.	Tons.	Price per ton.	Cost clearance per acre.	Revenue per acre.	Total revenue.
Potatoes	700	$100	$126	$500	$70,000
Cabbage	95	100	126	500	9,500
Carrots	38	100	126	500	5,800
Beets	10	100	126	500	1,000
Turnips	75	100	126	500	7,500
Parsnips	2	100	126	500	200
Rutabagas	65	100	126	500	6,500
Cauliflower	15	100	126	500	1,500
Celery	3	333	126	500	1,000
Greenhouse produce	25	1,000	.....	.....	25,000
HAY AND GRAIN.					
Oats hay	300	55	126	500	16,500
Ripe oats	10	90	126	500	900
Ripe barley	2	80	126	500	180
Winter wheat	2	90	126	500	180
Wild hay	300	35	126	250	5,250
Total	1,642	.....	.....	.....	151,010

Minor products raised from seeds, as follows: Brussels sprouts, rhubarb, leek, garlic, Swiss chard, parsley, cherval, sage, onions, lettuce, and radishes.

Appendix H.—REPORT ON AGRICULTURAL LANDS AND AGRICULTURAL POSSIBILITIES IN CERTAIN PORTIONS OF ALASKA.

[Report by H. H. Bennett and T. D. Rice, Bureau of Soils, United States Department of Agriculture.]

The following data are based upon reconnoissance investigations of the soils and field studies of the agriculture of the several regions investigated:

COOK INLET—SUSITNA REGION.

The agricultural lands of this region are comprised in the plainlike country and adjacent bench lands bordering Cook Inlet from Kachemak Bay northward and extending up the Susitna and Matanuska Valleys. The unfavorable climate and topography of the surrounding mountainous country restricts the farming possibilities to this low country, the approximate area of which is 6,000 square miles. At least one-third of this area, amounting to something over a million and a quarter acres (1,296,000 acres, the lowest estimate), consists of arable land possessing topographic and drainage characteristics, and chemical and physical properties quite favorable to farming. About one-half of this good land occurs in the Susitna and Matanuska Valleys.

The remainder of the lowland country largely represents marsh, isolated areas in the marsh, and areas of unfavorable topography. Extensive drainage operations will be required to reclaim the marsh (muskeg or "tundra"), and to make available the included well-drained land.

The climate is characterized by long, cold winters and short summers of moderate temperatures. At Tyonok, the mean summer temperature, according to nine years' records, is 56° F. The maximum temperature recorded is 91° F., and the minimum —27° F. The mean annual precipitation here is 23 inches, while the mean of the three summer months—June, July, and August—is 8 inches. The snowfall is 82 inches.

The growing season begins some time in May, and continues until the first of September. Under normal conditions, killing frosts are not likely to occur over the greater part of the region during this period. There are, however, localities of peculiar climatic environment where chilling winds or unseasonable frosts are likely to injure crops at any time. The long hours of summer daylight add to the growing season.

The following crops have proved successful: Potatoes, a large number of vegetables, small grain, and grass. Native redtop grass grows abundantly throughout the region. Cut at the right time, this makes good hay, both the results of actual feeding and the chemical analysis indicating good nutritive value. This grass yields upwards of three tons of hay per acre and it will afford feed and pasturage for a large number of animals.

Early varieties of barley and oats mature, producing good yields of grain. Wheat and rye have been matured, but these crops are not so promising as oats and barley. All small grains will produce good yields of hay, even in years of abnormally early frost.

Over 200 bushels of potatoes per acre are grown on the good soils without fertilization. The potatoes are of good quality when started early on well-drained soil in sunny situations. This crop will succeed throughout the region on the better grades of land, such as the extensive Knik loam soil.

Cabbage, turnips, lettuce, beets, spinach, and a number of other vegetables of good quality are easily grown on all of the arable soils.

Cattle have been raised on a small scale at Ninilchik for years. Elsewhere no important effort has been devoted to the industry. There is no question regarding the possibility of raising stock in this region. The native grasses will afford large quantities of hay, as well as a good summer pasturage. Native hay supplemented with locally produced grain, hay, and root-crop forage will provide feed necessary for the long winters. From the latter part of May until some time in September the animals will maintain themselves on native pasturage. The necessity of feeding stock upwards of seven months in the year imposes more restrictions upon the industry than are encountered in warmer regions and in those regions where the animals maintain themselves most of the year upon ranges.

The climate and soil make possible the establishment of an important agriculture in the Cook Inlet-Susitna region. Development will follow along pioneer lines at first, leading eventually to the establishment of many comfortable homes, supported largely by the products of the farm. The possibilities of raising stock and dairying point to the furtherance of agriculture, eventually, to a position of importance considerably beyond a self-supporting stage. The building of a railroad through the Susitna and Matanuska Valleys will make accessible a large area of good farming land, and unquestionably settlement will follow, probably as a rapid rate. Already 150 homesteads have been registered at the Knik office, and others have been taken up. A number of prospectors and miners, most of whom previously had not been identified with agriculture, are now supporting themselves in the neighborhood of Knik largely with the products of their farms.

YUKON-TANANA REGION.

The region comprising the bottoms of the Lower Tanana River, the highlands to the north, and the bottoms of the Yukon River north of this, embrace a large area of agricultural land, including considerable areas of the best farming soil seen in Alaska, along with very large tracts of fair-to-good agricultural soil.

The lowest estimated area of available farming land in this region is 4,500,000 acres. In this estimate only 50 per cent of the 7,000 square miles of the Lower Tanana bottoms is included, and less than 25 per cent of the uplands lying to the north of the Tanana River. In the sections covered the proportion of farming land was larger than this, and it is probable that figures given fall short of the actual area of arable land. In this estimate the large area in the Yukon bottoms was not taken into account because of its northerly latitude, yet it is recognized that farming is possible in the Yukon bottoms.

In the Tanana bottoms the soils are mainly sandy and silty; they are flat, mostly well drained, easy to cultivate, and are easily cleared. It would be a simple matter to drain the wet lands occurring in these bottoms. Those that are not well drained produce much good grass.

On these soils good crops of vegetables and grain hay are produced. Immense quantities of hay and good grazing can be derived from the native grasses which thrive on these soils. In addition, large quantities of grain hay and root-crop forage can be easily grown.

Potatoes from the Tanana bottom soils do not have as good reputation for quality as those grown on the southerly slopes of the hill country to the north; but with proper management the early varieties give a product of at least fairly good quality. All potatoes which do not come up to the desired standard for the table could be used for stock feed.

In the hills north of the Tanana bottoms is found the best soil seen in Alaska. This is a deep, mellow silt loam (Fairbanks silt loam), having good drainage and moisture-holding capacity. It occurs on the lower slopes and is largely susceptible of easy cultivation. There are approximately a half million acres of this valuable soil. This type of soil is the same as that at the Fairbanks Experiment Station, where such good results have been had with grains and potatoes. On the southward-facing slopes it yields over 200 bushels of potatoes per acre without fertilization.

Early varieties of oats and barley mature in normal years. Wheat and rye also have matured at the Rampart and Fairbanks Stations. All varieties of grain give good yields of hay on this soil, even in years of early frost. Turnips, cabbage, beets, lettuce, and several other vegetables are grown with unusual success, both as regards quality and yield. Native redtop grass springs up thickly immediately following the removal of timber.

There are still larger areas of other cultivatable soils on the slopes of the hilly country. These are not so deep as the Fairbanks silt loam, but they produce good crops of excellent potatoes, various vegetables, grain, and grass. Probably 1,500,000 acres of such land exist in the country between the Tanana and Yukon Rivers.

Other soils of agricultural possibilities are found in the bottoms of the small streams and on the bench lands of the region.

The winters of this portion of Alaska are colder than those of the Cook Inlet region, while the summers are somewhat warmer. The mean summer temperature at Rampart, according to seven years' observations, is 58° F. The minimum temperature here is —68° F. and the maximum 96° F. The mean annual rainfall is 10.35 inches; about two-fifths of this in the growing season. The snowfall is 53 inches. Evaporation is light and rain falls so slowly that a very large proportion is absorbed by the soil. A large part of the melting snow also is taken up by the soil and conserved for later plant use. The growing season covers the period from about the last of May to about the first of September. The long duration of summer daylight has the effect of lengthening the growing season.

In view of the fact that the early varieties of grain, particularly oats and barley, always mature in normal seasons, and that all varieties produce good yields of hay, coupled with the possibility of a large production of native hay, it is evident that the region can support a large number of cattle and other stock.

There are several dairies at which cattle have been successfully raised and milk and butter produced in a very satisfactory way. The raising of hogs in a small way has met with success throughout the region. Success has also attended the raising of chickens and ducks. No attempts have been made to raise sheep and goats, but it is possible some breeds would thrive here.

The past summer a large quantity of native hay was cut for horse and cattle feed. Enough potatoes were grown to supply the population of the region, and in addition shipments were made down the Yukon River. Considering the crop possibility of the large extent of farming land, the region is obviously capable of supporting a very much larger population. Already a considerable number of farms are being successfully operated, producing vegetables and potatoes for home use and sale and native grass and grain hay for stock. With cheaper and better transportation facilities an increased number of homesteaders will take up lands, and it is believed the region will be brought gradually to a place of considerable farming importance. The most promising line of agriculture is the production of grain hay and root crops as a basis for stock raising.

COPPER RIVER REGION.

There is a large extent of country in the upper Copper River region, northward from the vicinity of Copper Center, which has a quite favorable topog-

raphy for agricultural operations. The soil, however, is not so favorable, being predominantly of a clayey character, and so stiff and cold natured that it is doubtful whether it could be farmed with much success. Heavy teams and tools would be required to manipulate such clay land, and crops likely would make slow growth owing to the impervious, cold nature of the soil. Furthermore, the climatic conditions of the region appear to be less favorable than in either the Cook Inlet-Susitna or the Yukon-Tanana region. Vegetables and grain hay, however, are being successfully grown on the bottom soils and more loamy types of the uplands. Some cattle have been raised at various places in the region along the Valdez-Fairbanks road. Stock raising and dairying would likely be found the most remunerative types of farming.

COMPARISON WITH FINLAND.

In comparing Alaska with other countries of similar latitude and climate a close relationship is found to Finland, a country of considerable agricultural importance. Finland and Alaska are largely included between the parallels 58° and 70° north latitude. Alaska is bordered on the north by the Arctic Ocean and Finland nearly touches the Arctic. The cultivated area in Finland comprised about 7,000,000 acres in 1901. In 1909 the country produced 19,759,488 bushels of oats, 12,084,853 bushels of rye, 4,887,319 bushels of barley, 19,226,108 bushels of potatoes, 7,766,203 bushels of turnips, and 2,895,087 pounds of flax and hemp. The output of butter for this year amounted to 26,585,600 pounds. In 1911, 18,805,884 pounds of butter were sold to Great Britain, and considerable quantities of butter, cheese, and milk were sent to Russia, Germany, and other countries.

The number of the principal domestic animals in the country as reported for the year 1907 is as follows: Cattle 1,491,264, sheep 904,447, swine 221,072, and horses 327,817.

Finland exported in 1912 $8,679,400 worth of live animals, meat, game, and butter products, and $46,012,100 worth of wood pulp, paper, and manufactures of wood.

The most promising outlook for exports from the Cook Inlet-Susitna and Tanana Valley portions of Alaska is in the raising of stock and production of dairy products. The experiments made at Kenai, on Kenai Peninsula, by a station of the Agricultural Department showed that cattle could be successfully raised here and that milk and butter could be satisfactorily produced, using only locally produced feed.

Cattle raising and dairying also have proved successful in the Tanana Valley.

At present these industries are of little importance, but eventually the entire region may be devoted to them. Possibly the greatest profit will be derived from the production of milk, butter, and cheese. Under practically the same conditions of climate dairying has proved successful in Finland, the country exporting in 1912 $8,679,400 worth of live animals, meat, game, and dairy products. Most of this consisted of dairy products.

An estimate of possible beef and milk production on the best farm lands of the Cook Inlet and Tanana Valley regions of Alaska under highly developed conditions is given below.

SUSITNA AND MATANUSKA VALLEYS.

In the Cook Inlet-Susitna region there are approximately 1,296,000 acres of the better class of farm land (land available without expensive drainage). About 648,000 acres of this lie in the Susitna and Matanuska Valleys. Figuring 8 acres to the animal, this area will support 81,000 head, counting one-sixth of these ready for market as 2-year-olds, 13,500 head or 500 carloads (of 27 head each) would be ready for shipment each year, with the entire acreage devoted mainly to the raising of cattle. In beef this would amount to 4,050 tons per year, the 2-year-olds weighing 600 pounds each.

In the production of milk a herd of 81,000 would be divided as follows:

Cows	56,700
Yearlings (20 per cent of herd)	16,200
2-year-olds (10 per cent of herd)	8,100

With 56,700 cows giving 6,000 pounds of milk each per year, there would be produced 340,200,000 pounds of milk, or 170,100 tons of milk. This converted into butter (3.7 per cent of milk) would equal 6,293 tons, and into cheese (9 per cent milk) it would equal 15,309 tons. Producing half beef and half milk the estimated capacity of the area would be 2,025 tons of beef and 85,050 tons of milk, or 3,146 tons of butter.

YUKON-TANANA REGION.

The 4,500,000 acres of the better farming land in the lower Tanana Valley region, at 10 acres per head, would support 450,000 cattle.

With one-sixth of this herd salable as 2-year-olds, 75,000 head would be ready for shipment each year, with the land devoted principally to cattle raising. On foot this would amount to 2,777 carloads; as beef it would amount to 22,500 tons.

In the production of milk a herd of 450,000 head would be constituted about as follows:

Cows	315,000
Yearlings	90,000
2-year-olds	45,000

With 315,000 cows giving 5,000 pounds of milk each per year, there would be produced 1,575,000,000 pounds of milk per year, amounting to 787,500 tons of milk, or 29,137 tons of butter, or 70,875 tons of cheese.

Producing half beef and half milk the estimated capacity of the area would be 11,250 tons of beef and 393,750 tons of milk, or 14,568 tons of butter per year.

The following table gives the areas of the principal soils and groups of soils in the Yukon-Tanana region covered by the reconnoissance soil map:

Areas of principal soils in Yukon-Tanana region covered by reconnoissance soil map, with an estimate of the least area of each available for cultivation.

Classification.	Square miles.	Per cent.	Lowest estimate of areas available for cultivation.	
			Square miles.	Acres.
Mainly Gilmore soils and stony mountainous areas between Tanana and Yukon Rivers	11,368	43.9	2,500	1,600,000
Tanana soils (mainly)	7,553	29.2	3,500	2,240,000
Mainly Yukon soils, south of Yukon River [1]	4,119	15.9	.....	.....
Goldstream silt loam (mainly)	1,053	4.1	250	160,000
Fairbanks silt loam (mainly)	816	3.2	733	469,120
Tanana silt loam (mainly)	579	2.2	100	64,000
Rampart silt loam (mainly)	400	1.5	100	64,000
Total	25,888	.....	7,183	4,597,120

[1] The Yukon soils are not included in this estimate of present available agricultural land on account of their northerly latitude. It can not be denied, however, that they possess farming possibilities.

The following table gives the areas of the principal soils and groups of soils in the Cook Inlet-Susitna region covered by the reconnoissance soil map:

Areas of principal soils in Cook Inlet-Susitna region covered by reconnoissance soil map, with an estimate of the least area of each available for cultivation.[1]

Classification.	Square miles.	Per cent.	Lowest estimate of areas available for cultivation.	
			Square miles.	Acres.
Muskeg and included soils [2]	2,280	38.8	.....	.....
Knik loam (mainly)	1,975	33.6	1,300	832,000
Knik loam, high-bench phase (mainly)	960	16.3	400	256,000
Susitna soils (mainly)	415	7.1	100	64,000
Knik loam, shallow phase (mainly)	190	3.2	175	112,000
Knik fine sandy loam (mainly)	60	1.0	50	32,000
Total	5,880	.....	2,025	1,296,000

[1] The region covered in these estimates is restricted to the lowlands and benches lying north of Kachemak Bay, on the east side of the inlet, and north of Tyonek on the west side.

[2] Extensive drainage operations will be required to reclaim Muskeg and to make available the included well-drained soils (Knik).

Appendix I.—COAL AND WOOD CONSUMED IN FAIRBANKS CITY AND FAIRBANKS DISTRICT.

Table of gold-bearing creeks adjacent to and having Fairbanks, Alaska, as their base of supplies—Showing area unworked, estimated values per square foot, output if worked and estimated tonnage of coal in comparison with number of cords of wood (with average price) used yearly in operation of following creeks.

Creeks.	Area.	Value.	Output.	Wood.	Cost.	Coal.
	Square feet.			*Cords.*		*Tons.*
Cleary	8,980,000	$0.463	4,159,900	15,903	$200,640	7,951
Chatanika	1,530,000	.432	6,610,000	7,481	63,950	3,741
Chatham and Wolf	600,000	.40	240,000	1,460	21,900	730
Dome	2,650,000	.493	1,307,000	3,595	27,412	1,797
Engineer	150,000	.50	75,000	700	7,350	350
Ester and Cripple	2,900,000	.491	1,425,000	8,030	76,650	4,015
Fairbanks	4,950,000	.466	2,280,000	8,597	132,789	4,298
Gilmore and Twin	2,800,000	.526	1,475,000	2,910	32,010	1,455
Goldstream	9,400,000	.447	4,202,000	14,812	174,037	7,406
Eldorado	600,000	.40	240,000	2,007	22,077	1,004
Pedro	2,925,000	.447	1,310,000	9,124	88,139	4,562
Vault	1,000,000	.46	460,000	2,555	17,885	1,277
Total	52,255,000	[1].455	23,783,500	77,174	864,839	38,587

[1] Average.

Average cost wood per cord, $11.25.

Estimate of the number of cords of wood consumed annually at Fairbanks City, Alaska (not including the mining district), for heating and power purposes, and comparative statement of number of tons of coal that would be consumed if available.

Heating:	
Wood, cords	9,000
Coal, tons	4,500
Power:	
Wood, cords	9,500
Coal, tons	4,750
Total number of tons of coal that would be consumed	9,250
Average cost of wood per cord	$10
Total cost of wood annually	185,000

Appendix J.—DESCRIPTIVE REPORT OF UNITED STATES COAST AND GEODETIC SURVEY HYDROGRAPHIC SHEET NO. 3674, SHIP CREEK TO MATANUSKA RIVER, KNIK ARM, COOK INLET, ALASKA.

There is a peculiar interest attached to Knik Arm just at present—at least, to persons whose interests and welfare are contingent on the development of Alaska—because of the probability that the contemplated Government railroad will pass through that region. That this interest has been accentuated and concentrated on this locality is due to the fact that the Alaskan Engineering Commission have made their headquarters at Ship Creek and are extending their surveys from that point.

It is scarcely within the province of this report to enter into a detailed discussion of possible routes for this railroad. It does, however, seem to me eminently proper to give to this, as to all branches of governmental or private activity, such consideration as to their relation to this service as will enable us to keep in advance of any demand for information which may be made upon us. For this reason I feel justified in expressing my opinion—an opinion, however, based solely on my own observations and study of conditions—that if a railroad is built it will follow the south shore of Knik Arm, and that Ship Creek will be one of the most important tidewater points on the line—certainly for construction and very possibly as a permanent shipping point as well. As to construction, the reasons for this statement are obvious. It is conceded that

for a road in this region the two possible terminals other than Ship Creek itself are Seward and Passage Canal. For purposes of construction, Ship Creek possesses decided advantages over either of the others. Passage Canal, in fact, need not be considered at all, since it is cut off from the remainder of the route by high land which must be pierced by a tunnel some miles in length. The advantages of Ship Creek over Seward are:

First. The former has unlimited space for the storage of supplies and equipment.

Second. That from there work can be carried in both directions simultaneously.

Third. That it is the nearest available tidewater point to the Matanuska coal fields, and, obviously, the first work done would be to carry the road through to these fields in order to obtain coal necessary for subsequent work.

As to the suitability of Ship Creek as a permanent shipping point for this coal, conclusions are not so obvious. There is much to be said on both sides of this question. As already stated, Ship Creek has unlimited room for terminal facilities; the haul is about 55 miles less than to Passage Canal and 100 miles less than to Seward. Ship Creek, moreover, possesses the advantage of unlimited anchorage room, except in so far as its waters may be obstructed by ice during a portion of the year, whereas the area available for this purpose both in Resurrection Bay and Passage Canal is extremely limited.

On the other hand, there will undoubtedly be a portion of the year when navigation in upper Cook Inlet will be impeded by ice (this question of ice will be discussed in detail later in the report), and the distance from ports in the United States to Ship Creek is greater than to either Seward or Passage Canal. This latter objection, however, seems to me of slight importance, since, as long as it is assured that the railroad will follow this route, this section will attain to an importance which will compel vessels on regular southwestern Alaska routes to call there irrespective of whether coal is shipped out or not, while to vessels carrying coal alone the slight extra distance would be of no importance.

In view of these facts, it seems plain to me that if the route finally chosen for the railroad be the one to which the present commission seem inclined, Cook Inlet during the next few years will be the scene of traffic much more extensive than any other part of southwestern Alaska, and, consequently, that the need for accurate and detailed charts and for extensive aids to navigation will be correspondingly increased.

Because of the unusual importance which, for the above reasons, is attached to this region, a special effort was made to obtain all possible information which could be utilized by this service. Much of the information obtained applies to Hydrographic Sheet No. 3200*a*, covering the resurvey from Ship Creek to Fire Island. It was not, however, included in the report on that sheet, as it seems to apply more particularly to this one, and to give the same information on both reports would be a needless repetition. In considering this report, therefore, the reader should bear in mind its application to the Fire Island sheet.

The report is divided into two general parts:

First. General information about the region, such as would be useful in compiling sailing directions, etc.

Second. Information pertaining particularly to the survey itself.

The former is given first, as the information there furnished will throw light on details of the survey which might otherwise be obscured.

GENERAL STATEMENT.

Upper Knik Arm is an estuary having, in exaggerated form, the characteristics of such bodies of water. At its head are two rivers of considerable size, the Matanuska and the Knik, which, flowing through soft alluvial soil and aided, at least in the case of the Knik, by glacial action, carry down large quantities of silt. To the action of these streams are opposed the forces of a tide of exceptionally great range, a range attaining a maximum of about 40 feet and giving rise to currents with a velocity in places close to 7 knots.

The result of such an opposition of forces is that Knik Arm, from a point 5 miles above Ship Creek to the head of the arm, is one vast mud flat, in places bare at all times except on one or two of the highest tides of the year; mostly bare at half tide and entirely bare at low water except for local depressions or irregularities in those areas which on higher stages of the tide might be called channels.

On the south side of the arm the shore rises in a bluff throughout the entire extent, except in the vicinity of the streams emptying into the arm, which are bordered by marshy areas of small extent. The land is from 50 to 150 feet high, rolling hills extending back to the range of mountains which separates Knik and Turnagain Arms.

On the north side the land is rolling for miles back from the shore, so much so that Mount McKinley, 150 miles away, seems to rise out of a level plain. The upper part of the arm is bordered by an extensive area of marsh.

On both sides the geological formation consists of soft earth or gravel of glacial rather than aqueous origin, if one may judge from the large bowlders found embedded therein. At only one place is there known to be any outcroppings of rock immediately adjacent to the shore. This is at Old Knik, on the south side of the arm, just below the mouth of the river, where are found two small rocky buttes.

CHANNELS.

At the present writing these may be grouped under two heads—the main channel up the arm and the various secondary ones leading from the different streams at the sides. From the clear water above Ship Creek the main channel follows the shore of Goose Bay to the vicinity of △ Crow, then leads diagonally across the arm toward the buttes at Old Knik. It holds this direction for about 7 miles to a point abreast of Fire Creek, where it lies a little over a mile offshore. From this point it parallels the south shore, keeping about 1½ miles off until it reaches the Eklutna River, where it again leads toward the two buttes, passing close to the south shore until just before the buttes are reached. It then leads across the arm to the north shore, passing east of the small marshy island opposite the buttes, and so follows close along the north shore into the river. This is the only channel which can be followed the entire distance through the flats into the river. The sheet will show indications of others and may not clearly show (the soundings are not yet reduced or plotted as this is being written) that they are merely blind leads, but such is known to be the case, both from our own experience and observations and from information obtained from others familiar with the locality.

The various secondary channels require but the briefest mention. These are formed by the various streams at the sides, but flatten out and disappear as the strength of the current is dissipated in the open waters of the arm. The channel which follows the south shore is of this character. Good water may be carried as far as the palisades, but this channel ends just above △ Finis 2. The channel to Knik follows the main channel to △ Crow, then leads close along the shore to the town.

In considering this subject, it should be borne clearly in mind that what are here called channels are such only at or near high water. All navigation must be done on tide, particularly in the upper arm, and the launch which lingers long in that locality after the tide begins to fall will find itself stranded to wait for the next high water.

The question of the permanence of the present channel is of the greatest importance, and a special effort was made to obtain all possible information on this subject. To Mr. G. M. Palmer, storekeeper and postmaster at Knik, I am indebted for the following information on this subject. Mr. Palmer has been in this region for about 30 years, and during much of that time kept a journal in which he recorded much interesting information regarding meteorological conditions, prevalence of ice, and locality of changes in the channel. Personally, I place particular confidence in the information furnished by Mr. Palmer, since he alone of all the men interviewed seemed to be unprejudiced in his statements by a wish to make them as favorable as possible, in order to throw no possible impediment in the way of the railroad passing through this region. Mr. Palmer states that these channels are constantly changing and that the changes are of two kinds:

First. There is a gradual change, which is going on all the time; channels deepening in one place and filling in in another or shifting slightly in position, the amount of this change depending upon the amount of rainfall in the basin drained by the various streams emptying into the arm. This change would be but slight for any one year, but extending over a period of years, its effect is to make marked differences in the channels. At present, he states, the channel leading to the town of Knik is filling in rapidly.

Second. The arm is liable to be visited by a flood of considerable proportions, which, in a few hours, will change its entire configuration. These floods

have their origin in a large lake drained by the Knik River. It seems that there are two glaciers on the upper reaches of this river, or possibly that the one large glacier, located about as shown on the chart, has broken in two. Between these two glaciers lies a lake said to be quite as large as Knik Arm itself, the lower glacier forming a barrier which dams up the water. Mr. Palmer states that this lake was visited by a prospector of his acquaintance, who described it to him, and that the report was confirmed by two other prospectors, who later visited it independently.

About 15 years ago the waters of this lake burst through the ice barrier which confined them and flooded the arm. Previous to that time the channel up the arm had followed the north shore until up to, or a little above, the present town of Knik, then turned toward the center of the arm, which it followed to the river. The débris carried down by this flood entirely filled up all channels, so that the present ones have been cut since that time. The Indians of this region state that these floods are liable to occur about every 15 or 20 years.

As a further indication of the extent to which changes are taking place in this arm, it is interesting to note Mr. Palmer's statement that 20 years ago the present flats on the north side of the arm opposite Fire Island did not exist, the channel at that time being close along the north shore to the mouth of the Susitna River.

TIDES AND CURRENTS.

The predicated maximum range of tide at Ship Creek is about 40 feet. The greatest range actually observed by this party was 36 feet, but these observations were not taken during the period when the highest tide of the year might be expected to occur. A note just received from Mr. Edes states that on August 24, with calm weather and smooth sea, the high water reached a point 1.886 feet higher than the highest tide observed by the *Explorer*. This tide, therefore, would reach 38 feet on the staff. Simultaneous observations showed that the high water occurred 1 hour and 10 minutes later at Old Knik than at Cairn Point. The difference between Ship Creek and the town of Knik is said to be 1 hour.

These tides give rise to currents of considerable velocity. Observations taken by the *Explorer* at the anchorage show a maximum of 4½ knots per hour, and since the anchorage chosen for the *Explorer* was always one where there would be the least possible current, it is fair to assume that they attain a velocity at times of at least 5 knots in the channel. The strongest currents encountered were along the north shore just above Goose Creek, where they attained an estimated velocity of at least 7 knots. It was impracticable to take observations in this vicinity, however. On one occasion the launch attempted to anchor here, but could not hold on against the current. Thus, although Goose Bay is the head of navigable water in the arm, it is unsafe to attempt to anchor there, because of the current and of the limited swinging room. The steamer *General Hubbard*, which, a year ago, carried up equipment for the party engaged in carrying from the Matanuska coal fields to tidewater the 800 tons of coal intended for test by the Navy, did indeed land her freight at this point, but she was in trouble all the time, frequently compelled to steam full speed ahead to hold her position, and on one high water was forced clear up on the marsh, where the receding tide left her high and dry. She was later floated without damage, but her experience was not such as to induce others to follow her example.

ANCHORAGES.

The anchorage universally used is the one off Ship Creek, described in my report covering the resurvey from Ship Creek to Fire Island. The anchorage commonly used by the *Explorer* during the season was about 6 miles above Ship Creek, in the center of the deep area which lies about three-fourths of a mile north true from △ Genus. This anchorage was used in order to be as close to the work as possible. Otherwise, it is decidedly inferior to the one at Ship Creek and is not recommended for general use.

ICE.

On this subject I found it difficult to obtain what I considered accurate and unprejudiced information. Most of the persons interviewed, who had been residents in the vicinity long enough to have any information to offer on the sub-

ject, seemed to realize that it would be one of the vital factors in determining the importance of Ship Creek, and were therefore inclined to present the matter in the most favorable light possible. From what I could gather, however, the following is about what might be expected: Considerable ice may be encountered at any time between the last of December and the last of April, the amount, of course, depending upon the rigor of the winter. This ice forms in the upper arm, is broken up and carried down by the big tides of the month and grounds on the flat alongshore, particularly in the basinlike area between Cairn Point and Point Woronzof, where it accumulates. While it may not attain any great thickness, there is certainly enough of it in the strong current to endanger any vessel which encounters it. On the other hand, there will be a considerable portion of each month when the channels are practically clear, these times occurring immediately after the period of highest tides. The situation may be summarized by saying that the vessel which could afford to wait for a few days for a favorable opportunity could probably reach Ship Creek without difficulty, but certainly could not count on remaining there any length of time to discharge and take on cargo, unless a basin were dredged out at Ship Creek to receive her.

I may add that the Alaskan Engineering Commission has secured the services of an experienced man who will be stationed at Ship Creek during the ensuing winter to observe the amount and the behavior of the ice, and so inform them more positively as to its importance.

AIDS TO NAVIGATION.

If Knik Arm attains to the importance suggested in this report, it will become imperative to have efficient aids established throughout Cook Inlet. To my mind these should be—

First. A light on Anchor Point.

Second. An efficient light and fog signal on the east foreland.

Third. A light on Fire Island, established at Race Point rather than on the southwestern end of the island as formerly.

Fourth. A channel buoy or range marks to serve as a guide through the shoals off Fire Island. Nothing, I believe, will be required above Ship Creek. There will be but little traffic through the flats to the head of the arm, and for that little local knowledge is necessary in any case.

INDUSTRIES.

In this region there is considerable land capable of agricultural development. Already a number of homesteads have been taken up where agriculture upon a limited scale (gardening rather than farming) is carried on. Vegetables of various sorts and of excellent quality can be raised, but the region labors under the obvious disadvantage of having no market for its products. The town of Knik is the metropolis of this region, furnishing supplies for the mines in the interior, these supplies being carried by launches up the Susitna River to Susitna Station, then by trail about 70 miles to the mines. Knik, at present, however, is merely a boom town. Most of the people there have been attracted by the prospect of a railroad in the vicinity, and as soon as the location of the road is definitely decided, will undoubtedly move to some point along the line.

WEATHER.

During the present summer the weather in Knik Arm was the most delightful I have encountered anywhere in Alaska. The days were bright and warm with very little rain, and that little more like passing summer showers than the characteristic Alaska drizzle. There was also little or no wind, particularly above Fire Island. On various occasions when it would be blowing a gale out of Turnagain Arm, there would be calm, or only gentle breezes at Ship Creek. This condition is said to prevail during the summer months. In winter, however, conditions are not so good, heavy winds blow down the arm at times, which winds, combined with the strong ebb tide, would undoubtedly render any anchorage far from secure.

DETAILS OF SURVEY.

Instructions for this work were to carry triangulation, topography, and hydrography from the limits of previous work to the head of the arm, the hydrography being such as to define the sloughs in the flats to the mouth of

the Matanuska River and to show the depth which could be carried at high tide over the entire area. The nature of the work called for in this assignment, while not particularly difficult, was tedious, due to the necessity of working entirely on tides and attended by a certain amount of risk because of the strong currents encountered, and of the lack of experience of most of the officers assigned to the party. The ship, when at anchor, required constant watching, as the strain on the cable was at all times severe and sometimes excessive. Twice during the season shackles in the chain spread from the excessive strain, leaving the pin loose and in danger of working out. The personnel of field officers was weak for such work, Mr. Hunter being the only one in the wardroom who had had previous experience in the handling of small boats. It requires skill and good judgment to bring a small boat safely alongside a ship at anchor in a 4½-knot current, and for these two reasons I considered it imperative, particularly during the early part of the work, that either Mr. Hunter or myself should be on board at all times, in order that there might be some one to take prompt and efficient action in case of emergency. I was therefore compelled to trust a considerable portion of the work to officers who had had no previous experience, with the result that the work progressed slowly, and part of it, in the case of triangulation, had to be gone over a second time. As soon as possible a combined triangulation and topographic party was put in camp at the head of the arm, as much to minimize the risk of accident as to facilitate the work.

In executing the hydrography it was possible to work only at or near high water. To take the greatest possible advantage of this short working period, the development of the flats was made by lines run normal to the direction of the channel, spaced first one-fourth mile and later one-half mile apart. These lines were run at extreme high water in order that they might cover as extensive an area of the flats as possible. A further development of the channel, made necessary by this wide spacing of cross lines, was obtained by carrying a line of soundings each day to and from the work, running up on the last of the flood and returning on the first of the ebb. This method had the further advantage that the channel lines were run at all times in the direction of the current, so that the effect of the latter upon the lead line was minimized.

Tides were observed at Cairn Point, the station of 1910 being reoccupied. A supplemental station was established at Old Knik, where observations were taken to determine the difference in time between the two stations. The soundings were then reduced by applying the correction to the observed time at Cairn Point proportionally to the distance from that point, the range, in the absence of information to the contrary, being taken as the same at both stations. This amount of tidal data is perhaps meager, but there was no place above Palisade on the one side and Crow on the other where observations could be taken, as the entire area along the shores above these points bares at low water.

Triangulation was carried to two points within sight of the head of the arm, and a base measured above the town of Knik and connected with the triangulation.

A table of statistics of hydrographic work is attached.[1]

Respectfully submitted.

R. S. PATTON, *Chief of Party.*

Appendix K.—REPORT OF H. C. GRAVES, UNITED STATES COAST AND GEODETIC SURVEY, ON VARIOUS HARBORS IN ALASKA.

DEPARTMENT OF COMMERCE,
COAST AND GEODETIC SURVEY,
Washington, January 21, 1915.

SUPERINTENDENT:

Complying with your directions I submit herewith for the Alaskan Engineering Commission a statement collating the various reports received by the commission relating to the harbors of Resurrection Bay, Portage Bay, Port Valdez, Cordova (Orca Inlet), and Controller Bay.

From a study of all the data it is concluded that any one of the harbors under consideration is available for use as a railroad terminal in the event that it is needed. Especially those that have limited anchorage on account of the great

[1] Omitted from this copy.

depth should not be deprecated. Observe that every criticism of Valdez and Resurrection Bay is due solely to the present location of the wharf, and a slight change in each case would enable vessels to go to the wharf and lie there securely under all conditions.

At Valdez the wharf extends across to the edge of the flat, and vessels must lie across the end of the wharf, broadside to the prevailing gales which draw down the valley. Hence the difficulty of making the wharf, also the liability to part the mooring lines of a vessel at the wharf during heavy weather. The dredging of a slip alongside the present wharf so that vessels could approach the wharf, and make fast alongside, head to the wind drawing down the valley, would obviate the difficulty.

Similarly at Seward, in the present position of the wharf, vessels alongside are broadside to the winds drawing up and down the valley. Hence the difficulty of making the wharf, and the liability of parting the lines while at the wharf, with northerly winds; also the liability to damage by vessels lying at the wharf by the local sea making up the bay with southerly winds. By building wharves along the east or west shores, or wharves with slips between across the flat at the head, so that vessels can go to a wharf and lie there head or stern to the wind drawing up or down the bay, all difficulty will be obviated.

Skagway is a good example of a condition similar to Valdez. There is no anchorage, but vessels have no difficulty in going to the wharf and lying there under all conditions, and it forms a satisfactory terminus for the White Pass & Yukon Railroad.

Seattle and Tacoma Harbors are examples of similarly sheltered waters where the depths are too great for ordinary anchorage. The suggestion has been made that mooring buoys might be used at Valdez, Seward, and Portage Bay; but the depths are generally more than twice the greatest depth in which such buoys are maintained at Seattle and Tacoma. The buoys at Seattle are in depths up to 32 fathoms; the scope of chain varies from 80 to 120 fathoms where the depths are 25 to 32 fathoms, or a ratio of about 3½ to 1. Applying this ratio to the depths in the Alaska harbors under consideration—say, 100 fathoms—and each buoy with a vessel attached would require a swinging room of about 1,400 yards. In order to keep the buoys in depths under 50 fathoms, some of those at Tacoma are maintained on the edge of the steep slope on the west side of the harbor. The following is an extract from the harbor regulations for Tacoma:

"Vessels mooring at city buoys do so at their own risk in all respects. Not more than one vessel shall be allowed to moor at a buoy at the same time."

These considerations suggest the necessity of providing wharves or mooring dolphins to which vessels can go under any condition of weather. With these provided, all experience on the Pacific coast warrants the conclusion that Valdez, Seward, and Portage Bay are available harbors for railroad terminals should they be needed. All have ample dimensions for maneuvering vessels, there are no tidal currents in the harbor, the depths are unlimited from sea to dock, and the approaches are sufficiently clear to insure a safe passage in clear weather.

Portage Bay has not been used by merchant vessels to any extent, but the surveys and satisfactory report by Mr. Gilbert T. Rude, of this survey, show that it is comparable with Valdez and Seward as an available port.

Cordova Harbor (Orca Inlet) is criticized only on account of the comparatively narrow channel for maneuvering vessels abreast the wharf, and the strong tidal currents. The narrowest part of the channel near Cordova has about the same width as the widest part of the channel of Norfolk Harbor at the important coal piers at Lambert Point; and the tidal currents at Cordova are somewhat less than those of the Hudson River between New York and Jersey City. As an anchorage, Cordova is acknowledged by all to be unexcelled in Prince William Sound.

A copy of the hydrographic surveys of Cordova Harbor (Orca Inlet) is furnished on a scale of 1–15,000, on which the best anchorage areas with depths greater than 18 feet are laid off in anchorage berths 400 yards apart, as allowed for the United States and foreign war vessels in Hampton Roads during the Jamestown Exposition.

CONTROLLER BAY.

Merchant vessels have had no occasion to use Okalee Channel, Controller Bay, as a harbor, and the experience in the contiguous waters of masters and pilots

is confined to Katalla. An examination of their statements shows that they are either general in character, without any explanations, or, in case details are given, their statements refer without question to the open roadstead at Katalla. The following samples, for insance, can refer only to Katalla, and yet are included in the answers relating to Controller Bay:

"Anchorage at Martin Island is unsafe. Have had to pass it on account of weather."

"Open roadstead. Have had to leave several times and lost several anchors."

"Have laid 12 days at Katalla in November and only able to discharge 250 tons. Had to leave after losing both anchors."

"Not acquainted in bay, but had to pass by on account of wind and sea."

"All southerly and easterly gales prevent anchoring in the bay."

"Unsafe on account of southerly and southeasterly winds and heavy swells."

"No anchorage when wind is from southwest. Exposed to ocean. Holding ground bad, quicksand. The harbor can not be used except under favorable conditions."

"We had to leave several times on account of southeast and southwest winds with a heavy sea. Unsafe on all considerations."

"Can always go in, but can not land in strong southerly weather."

The only available statements by navigators of vessels who have had experience in Okalee Channel, which is the harbor of Controller Bay, are by Government officers. On account of the conflicting reports relating to this harbor, I am including a somewhat detailed statement of facts, in order that the commission may be fully informed. I am impressed with the importance to the Atlantic coast of ports advantageously located for the shipment of coal by colliers and tows of several barges, such as Norfolk, Newport News, Delaware River, South Amboy, Perth Amboy, and others. Controller Bay should, therefore, not be eliminated in advance by reason of errors of judgment or other causes.

The available statements are by J. F. Pratt, of the Coast and Geodetic Survey steamer *Patterson*, who anchored in Okalee Channel from September 2 to 19, 1903, while surveying a part of the channel. Extracts of all items relating to the anchorage and harbor from the deck log of the steamer *Patterson* for this period are furnished.

Extracts from the descriptive report of the parties which completed the surveys of Controller Bay in 1909 are furnished.

Extracts from a report by the navigating officer of U. S. S. *Maryland*, who anchored here in 1913, are furnished.

The bar at the entrance of Controller Bay has a least depth of about 36 feet at low water or 45 feet at high water, as compared with 33 feet at low water and 38 feet at high water in the main ship channel over the bar at the entrance of San Francisco Bay. Spells of heavy weather, when the sea breaks on the bar at the entrance of San Francisco Bay, occur in winter; but this bar is exposed to all westerly winds from about northwest to south (true).

The bar at the entrance of Controller Bay is protected by Kayak and Wingham Islands and the coast westward, except from about southwest. Nearly all storm tracks pass well southward of Controller Bay, and the prevailing heavy gales are consequently easterly and northerly. The conclusion is that the occasions when the sea would break on the bar at the entrance of Controller Bay are much less frequent than on San Francisco Bar.

Currents.—For 15 days' continuous observations the mean velocity at strength of the flood and ebb currents at the anchorage used by the *Patterson* in Okalee Channel, Controller Bay, were 2.1 and 2.7 knots, respectively. For purposes of comparison, corresponding values are given for New York Harbor: Upper Bay, 1.8 and 2.3 knots; Hudson River off the Battery, 1.8 and 2.2 knots; and Hudson River off Thirty-ninth Street, New York, 2.1 and 3 knots.

The original current observations at Controller Bay do not indicate that the currents turn any quicker than at other places having similar velocities. For instance, there is generally an interval of one and one-half hours from the time of a 1-knot current in one direction, through slack water, to the time of a 1-knot current in the reverse direction.

Ice.—It is well known that heavy ice does not form in this vicinity in waters near the sea, such as Cordova and Controller Bay. These two harbors are comparable in every respect as to conditions for the formation of ice, such as position near the sea, prevailing winds, and extensive flats, and the conditions and effects of ice at Cordova should apply equally well at Controller Bay.

Anchorage.—During the Jamestown Exposition Hampton Roads was used as an anchorage for United States and foreign naval vessels, the anchorage berths being spaced at distances of 400 yards. Using this liberal spacing for Okalee Channel, Controller Bay, there are 35 of these anchorage berths in the inner part of Controller Bay from the bend southeastward of Kanak Island to the end of the 5-fathom depths at the head of the channel. In addition, there are 45 such anchorage berths in the outer part of Okalee Channel nearly out to the bar. Merchant vessels anchor very much closer than 400 yards in the channel off the coal piers at Lambert Point, Norfolk Harbor, for instance; and it is hard to conceive of any conditions that could exhaust the present capacity of Okalee Channel as an anchorage, it being necessary only to buoy the edges of the channel in order that it may be fully available. The dimensions of the channel can, moreover, be extended to any extent desired by inexpensive dredging of the flats.

A copy of the hydrographic surveys of Okalee Channel, Controller Bay, is furnished on a scale of 1:15,000, on which the anchorage areas with depths greater than 18 feet are laid off in anchorage berths 400 yards apart, as allowed for the United States and foreign war vessels in Hampton Roads during the Jamestown Exposition.

Respectfully,

HERBERT C. GRAVES,
Nautical Expert, Coast and Geodetic Survey.

HYDROGRAPHIC INFORMATION—ALASKA.

U. S. S. "MARYLAND," *August 4, 1915.*

Resurrection Bay.—This vessel used two anchorages in 32 fathoms with swinging room—one just south of Lowell Point and the other 400 yards from mouth of small stream flowing through the town of Seward. Neither one of these would be tenable in rough weather.

In Port Valdez we anchored midway between mouths of Gold and Mineral Creeks in 29 fathoms of water, with about 400 yards swinging room. The anchorages south of town of Valdez and off Fort Liscum were investigated, but none are tenable in rough weather.

The best anchorage in Prince William Sound, in fact, the best in south Alaska, is in Orca Bay. One 500 yards off wharf at Orca post office, one between Observation Island and Point Salmo, and another off Cordova Wharf and Spike Island, with 800 yards swinging room, all in about 8 fathoms water with good holding ground.

This vessel anchored for about seven days in Controller Bay. At south end of Kanak Island is an oil tank which is a prominent landmark in entering Controller Bay —— —— ——. Three spar buoys were located as follows: —— —— ——. Each is located in 5 fathoms water. In entering this harbor favor the south side. A good anchorage with no sea swell may be found 400 yards west-southwest true, from inner red buoy, but the bottom is hard sand, and near extreme low water the tide runs 2½ to 3 knots; this with a strong wind might cause a vessel to drag.

R. E. POPE.

Location, in middle of outer port of Oaklee Channal south by east (true) of south end of Kanak Island, and on the meridian line of 20 minutes on chart

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[Extracts from descriptive report to accompany hydrographic sheet of Okalee Channel, Controller Bay, season 1909, Paul C. Whitney; hydrographer, H. C. Denson, chief of party, commanding *Patterson.*]

Okalee Channel.—To be safely navigated by vessels this channel must be extensively buoyed from its mouth at Wingham Island up to the point that deep-water navigation ends. The flat on both sides of the channel cover a little after low water and there is nothing to indicate the location of the channel. There are no good ranges. The channel is entirely free from the ocean swell, Okalee Spit acting as a breakwater to the southward and the middle ground southward of Kanak Island breaking the sea from that direction.

The channel is kept open by the tide and has all the characteristics of such a channel. Its sides are steep, soundings shoaling rapidly on a south to north line near the edges.

The bottom is almost uniformly of hard, gray sand. Anchorages may be found anywhere in the channel, where the depths are suitable, with excellent holding bottom.

The tidal currents are strong, running out with an ebb tide and in with a flood tide. The estimated velocity of the current at spring tides is from 2 to 2.5 knots. It runs fair with the channel except along the sides where it spills off the shoals into the main current. The current runs out about one-half hour after low water at Kayak Island. There are small tide rips in the channel when the wind is blowing against the current. In the heavy easterly gales the local chop in the bay is too heavy for small launches to be safely navigated, but would not affect a ship.

[Extracts from *Patterson's* deck log, 1903, of all items relating to the anchorage in Okalee Channel, Controller Bay.]

September 2, at 3.15 p. m., stopped and anchored in 6½ fathoms. Position of anchorage: The bearings place it in the narrowest part of Okalee Channel, where it bends eastward, southeastward of Kanak Island. This position is also indicated by the position of the current observations on hydrographic sheet 2669.

September 8, meridian to 4 p. m.: Hove short to clear anchor at 2.11. Let go anchor at 2.33.

September 12: Sighted anchor at 4.45 p. m. Found all clear. Let go anchor at 4.50, 45 fathoms of chain.

September 14, midnight to 4 a. m.: Overcast and rainy, with wind squalls, increasing at times to strength of moderate gale, generally from E.NE. Executive officer called at 2.15 and anchor watch set.

From 3 to 8 a. m.: Weather overcast and rainy, with moderate E.NE.'ly gale during first half of watch. During latter half of watch wind hauled to E. by N., decreased slightly in force, became squally. Ship rode easily at anchorage.

September 15, midnight to 4 a. m.: Stiff SE.'ly wind, very gusty at times, overcast and clouded; raining throughout watch. Ship riding easily.

September 16, midnight to 4 a. m.: Weather overcast with continuous heavy rain. Wind from NE.; squally during first half of watch and increased in force to moderate gale during second half. No strain at anchorage.

September 17, midnight to 4 a. m.: Weather overcast and rainy, with frequent heavy showers. Squally NE. wind.

Sepember 18, 8 to meridian: At 9.55 steamer *Bertha* arrived in port. Steamer *Bertha* left port at 11.05.

September 19, 8 to meridian: Officers engage in preparation to close field work preparatory to sailing for Kiska Harbor.

From 6 to 8 p. m.: Anchor aweigh and half speed ahead at 6.10.

Appendix L.—REPORT OF H. C. GRAVES, UNITED STATES COAST AND GEODETIC SURVEY, COMPARING CONDITIONS IN KNIK ARM, ALASKA, WITH CERTAIN LARGE SHIPPING PORTS OF THE WORLD.

DEPARTMENT OF COMMERCE,
UNITED STATES COAST AND GEODETIC SURVEY,
Washington, February 1, 1915.

SUPERINTENDENT COAST AND GEODETIC SURVEY:

I submit herewith a statement relative to Knik Arm, in compliance with the request of the Alaskan Engineering Commission, dated January 25, 1915:

An inspection of the reports and surveys shows that the deeper and clearer parts of the entire arm are available for anchorage, having a total length of about 11 miles above the bar, and a clear width of not less than three-fourths mile. In addition there is considerable anchorage area in the deep water westward and northward of Fire Island. The anchorage, therefore, may be said to be unlimited in extent. Moreover, the greater part of Cook Inlet has moderate depths, furnishing temporary anchorage during thick weather in case of necessity.

The great range of tide, strong tidal currents, and estuarial character of Knik Arm give it a striking similarity to a number of well-known ports in England, such as Bristol Channel, for instance. The following data are included for purposes of comparison:

	Range of spring tides (feet).
Humber River (Hull)	19.9
Mersey River (Liverpool)	26.7
Knik Arm (Ship Creek)	35.4
Avonmouth (Bristol)	41.7

The following table gives the approximate maximum velocity at strength of the tidal currents:

	Knots at springs.
Humber River (Graham Roads)	3.0
Humber River (entrance)	4.2
Mersey River (Liverpool docks)	5–7
Bristol Channel	4–5
Knik Arm	4–5

A common feature in the ports of England is the wet docks with gates at the entrance, which are kept at a constant level near high water, vessels entering and leaving the docks when the gates are opened at high water. On account of the great range of tides, these docks are built in shallow water, and there is generally little depth at low water in the channels leading to them. As a consequence, by means of temporary dams the docks can be constructed in dry excavation and the cost greatly reduced. Knik Arm appears to be susceptible to such treatment. Such docks would afford also harbors secure from ice in winter. Sites for such docks appear to be unlimited in extent and number.

I understand that observations are being made by direction of the commission to determine the extent to which navigation is possible in winter. Considering the effect of ice in such Atlantic ports as Delaware River below Philadelphia, it is possible that there would be few occasions in ordinary winters that vessels could not go to Knik Arm, provided there was a secure ice harbor where they could lie on arrival.

St. Johns, New Brunswick, is an example of an important commercial port where vessels lie at the wharves subject to the tidal action. The spring range wharves ranges from 18 to 31 feet at low water, and at 18 there is 20 feet of high water alongside. The warehouses and sheds on these wharves are connected with the various railway systems by about 18 sidings."

HERBERT C. GRAVES,
Nautical Expert, Coast and Geodetic Survey.

Appendix M.—REPORT OF P. C. WHITNEY, UNITED STATES COAST AND GEODETIC SURVEY, ON CONTROLLER BAY, ALASKA.

DEPARTMENT OF COMMERCE,
UNITED STATES COAST AND GEODETIC
SURVEY S. S. "HYDROGRAPHER,"
Hertford N. C., January 21, 1915.

To the SUPERINTENDENT,
United States Coast and Geodetic Survey,
Washington, D. C.

SIR: I have the honor to submit the following report on Controller Bay, Alaska, for the information of the Alaskan Engineering Commission:

Controller Bay consists of extensive tidal mud flats crossed by winding channels of various widths and depths, with only one channel of sufficient size and depth to be commercially important, viz, Okalee Channel. This area lies behind and is sheltered by Kanak and Wingham Island to the westward and Kayak Island and Okalee Spit to the southward.

The eastern entrance between Okalee Spit and Kayak Island, and the southwest entrance between Kayak and Wingham Islands, owing to shoal water and flats, are of no commercial importance to large shipping. The entrance to the northward of Kanak Island is blocked by a shoal bar.

The entrance between Wingham and Kanak Islands is the mouth of Okalee Channel, and is the important entrance to the bay. This channel carries the

deepest water, and is the only navigable channel for deep-draft vessels in the bay. It extends from Wingham Island in a general easterly direction to the head of the bay, where it becomes the mouth of the Okalee River. At the entrance the bar depths are not less than 36 feet at low water. Once over the bar 40 feet can be carried up the channel for 3 miles east of Kanak Island, where the channel begins to narrow a good deal, but deep water extends over a mile farther eastward. To be safely navigated by vessels this channel must be extensively buoyed from its mouth at Wingham Island up to the point where deep-water navigation ends. The flats on both sides of the channel cover a little after low water, and there is nothing to indicate the location of the channel.

The channel is entirely free from ocean swell, Okalee Spit acting as a breakwater to the southward, and the middle grounds to the southward of Kanak Island breaking the sea from that direction.

Anchorage may be found anywhere in the channel where the depths are suitable, with excellent holding bottom, and there is abundant room for any number of vessels liable to use the bay. Owing to the character of the bottom, which is almost entirely of hard, gray sand, it would be easy to increase the width of any desired section by dredging.

During heavy weather and gales the local chop in the bay is quite heavy, enough to make launch work dangerous, but this would not interfere with shipping. I don't believe it would be any worse than in San Francisco Bay during the same weather conditions. At dead low water the water area is so greatly reduced that there is practically no rough water in Okalee Channel east of Kanak Island.

During the season of survey launches were used in all parts of the bay, and frequently were caught out in the middle of it during strong winds; but they always got back safely to the anchorage on the north shore of Kanak Island, east of the sand spit. This anchorage was used for four months. It is opened to the north and northeast, but there was only one occasion when a launch dragged, and then on account of a fouled mooring, nor at any time did the sea and wind put them in any danger.

During ebb tide, with a westerly sea and wind outside, there are heavy tide rips at the entrance to the channel north of Wingham Island, and these extend up the channel to south of Kanak Island, but to the eastward there are none. These rips at times are too heavy for small boats and launches; however, they would not bother large shipping.

The bay is free from the violent williwaws experienced in landlocked harbors of Alaska. The gales, when present, generally blow with a constant force.

The tidal currents are strong, running out with an ebb tide and in with a flood tide, the estimated velocity of the current at spring tides is from 2 to 2.5 knots. It runs fair with the channel, excepting along the sides where it spills off the shoals into the main current. The current runs out about half an hour after low water at Kanak Island.

Piers can be built free from ocean swell any place along the northern side of Okalee Channel from a point about 2 miles E. by S. (true) of the south end of Kanak Island, eastward for 1½ miles, where the channel narrows. These piers could be along the edge of the channel, with the docking faces parallel to the current or slips could be dredged out and vessels lie between the piers. These piers can be connected to the mainland to the northward by either trestlework or a riprap fill construction, similar to that at Oakland Mole, San Francisco Bay.

It might be suggested that a channel could be dredged from the section along Okalee Channel, proposed for the piers northward toward the mainland, thus shortening the riprap fill. It will be necessary, however, to determine the cost of this dredging and compare it with the cost of the riprap fill or trestlework.

The land from the mouth of the Bering River to the Okalee is marshy and flat for a mile or so back from the grass line, with high spring tides covering it. Dredged material could be used in building up the section where the shore end of the piers would come in. The country back rises with gentle slopes to the Bering Glacier and the bases of Mount Campbell, Mount Nichavak, and Mount Gandil.

The above information and suggestions result from four months' active survey work in Controller Bay during the summer of 1909.

Respectfully,

PAUL C. WHITNEY, *Commanding.*

Appendix N.—EXTRACT FROM REPORT OF CAPT. G. T. RUDE, UNITED STATES COAST AND GEODETIC SURVEY, ON PORTAGE BAY.

PORTAGE BAY (PASSAGE CANAL).

Prince William Sound may be entered in any weather when the landfall and aids to navigation can be seen.

Portage Bay, a tributary of the Sound, may be entered in any weather, with a probable exception of a heavy snowstorm, when landmarks are entirely shut out.

Fogs in this vicinity are the exception and not the rule. During the seven seasons spent in this section very little difficulty has been experienced from this source.

There are no tidal currents to interfere with the maneuvering of vessels, for which there is ample room.

Portage Bay, like all these Alaska fiords, is of excessive depth, 100 to 200 fathoms, and has a very limited anchorage area.

The only anchorage in the canal or bay itself is on the shoal area of limited extent on the south side about 3 miles from the head of the canal. Here good anchorage may be had in 10 to 20 fathoms, sticky bottom, with swinging room for two maximum size vessels and one up to 350 feet in length and 25 feet draft.

Good anchorage, with swinging room for one vessel up to 200 feet in length, maximum draft, may be had in Entry Cove, just under Point Pigot, at the entrance to Portage Bay, in about 13 fathoms, soft bottom.

Good anchorage, with swinging room for one vessel up to 325 feet in length, maximum draft, may be had in Passage Bay, indenting the south shore of Portage Bay about 6 miles from its head, in the hollow just inside Neptune Point, in 14 fathoms, mud bottom.

Fair anchorage, with swinging room for one vessel up to 300 feet in length, maximum draft, may be had in 12 to 14 fathoms, gravel bottom, at the head of Passage Bay, the bay indenting the south shore of the canal about 6 miles from its head.

Judging from the summer and fall weather only I consider Portage Bay a good harbor for a limited number of vessels. No sea nor swell enters the bay from the outside, and during that portion of the year spent by my party in these waters no williwaws were experienced.

Portage Bay is easy of access from the sea. A vessel can go from Hinchinbrook Entrance, the entrance to Prince William Sound, to the head of Portage Bay with not less than 100 fathoms of water under her and in no fear of outlying reefs or hidden dangers.

In regard to the dangers due to drift ice in Passage Canal, I consider them nil. During the part of two seasons spent in these waters, and that during the time the glaciers are working and throwing off ice, no ice whatever has been seen in the waters of Portage Bay nor in the approaches to this bay.

No ice is discharged into Portage Bay itself, as all the glaciers are dead and receding up their valleys.

At the head of Blackstone Bay a glacier is discharging some ice into that bay, but none of it has been seen as far out as the waters of Portage Bay. Ice is also being discharged from a number of glaciers well up Port Wells to the northward, but none of this has been seen as far south as the entrance to Portage Bay.

If docks be built at the head of Portage Bay on the south side, I am of the opinion that vessels can dock in any weather.

Appendix O.—SUMMARY OF REPORT ON TEST OF MATANUSKA COAL BY UNITED STATES NAVY, 1914.

PORT TEST, SEVEN DAYS.

All coal, ash, and clinker were weighed; one boiler was used; forced draft was necessary on two days. Run-of-mine coal was used for five days, slack for one day, and lump coal for one day. There were no casualties. Coal burned very freely. Firing was very good, the analyses of flue gases giving rarely below 9 per cent of CO_2. There was little clinker, but the ash was several per cent higher than with the Pocahontas coal. Draft was good and coal burned

with bright, yellowish flame. Coal coked very nicely; the coke was friable and very easily worked by the firemen. Fires 6 to 8 inches thick were carried most of the time, although occasionally they were heavier. The ash fused into clinker on the grate bars, generally about 2 inches thick, medium weight, porous, a little tough and hard while hot but friable when cold. The clinker had a little ash mixed throughout the mass. It stuck a little to the bridge wall, but not seriously. The soot deposit was about 25 per cent more than with Pocahontas coal. The soot was a little different from that of the Pocahontas, as the granules appeared as minute fused grains. The load during this week of test would ordinarily have required two boilers burning Pocahontas coal.

FOUR-HOUR FORCED DRAFT.

Fires thin, dampers partly closed. Fires burned brightly; work of firing very easy on account of ease of breaking up the coke. Furnaces one mass of yellowish flame. Not an excessive amount of ash formed. The men, on being questioned, all said it was the easiest 20-knot run they had ever made.

24-HOUR 15-KNOT TEST.

Started with 12 boilers, but necessary to cut out 4 boilers to get the highest efficiency. Coal burned with greatest ease, forming a very easily worked coke, not an excessive amount of ash or clinker, and in general appeared easier to handle than Pocahontas coal. CO_2 analysis generally high, over 9 per cent. Fires, carried 6 to 8 inches thick, were always glowing, ash pans bright, and the furnaces a mass of yellowish incandescent flame. Coal burned like pine knots. The amount of clinker was not excessive, was more or less easy to work, and very friable when cold. Fires were noticeably hot. Amount of soot made was a little higher than is usually made by good Pocahontas coal, about 10 per cent more.

10-KNOT TEST.

Started with six boilers, but it was found necessary to cut out two boilers to give greatest efficiency. This power was more than ample, as at times there were four evaporators in use. Fires were very easily worked; the coke broke up easy; clinker was not very hard; bright, level fires from 6 to 8 inches thick and sometimes thicker were carried; and CO_2 was generally high.

GENERAL REMARKS.

There was very little foreign matter. The slack appeared to burn better than the lumps. No evidences of gases being given off from the coal during the test. The noticeable characteristic of this coal is friability. Lumps pulverize very easily.

PORT TEST OF 7 DAYS.

Coal.	Total tons.	Gallons of water evaporated.	Pounds of coal per gallon.	Ash.	Efficiency.
				Per cent.	*Per cent.*
Pocahontas	94.291	248.610	1.168	11.04	100
Bering River	136.391	247.783	.811	36.6	69.4
Matanuska	116.185	305.446	1.777	15.8	100.8

4-HOUR, FORCED DRAFT, SPEED 20 KNOTS.

Coal.	Total tons.	Ash.	Smoke by scale.	Knots per ton.	Indicated horse-power.	Pounds per indicated horse-power.	Steaming radius.	Average efficiency.
		Per cent.						*Per cent.*
Pocahontas	79.1	8.8	2.4	1.02	20,820.3	2.09	2,367.8	100
Bering River	127.3	38.8	1.5	.60	13,992.3	5.32	.....	.....
Matanuska	85.484	18.67	2.8	.93	19,929.15	2.32	2,002.2	91

15 KNOTS, 24-HOUR TEST.

Coal.	Total tons.	Ash.	Smoke by scale.	Knots per ton.	Indicated horse-power.	Pounds per indicated horse-power.	Steaming radius.	Average efficiency.
		Per cent.						*Per cent.*
Pocahontas	153.155	7.6	1.25	2.38	7,083	2.01	4,781	100
Bering River	160.3	35	.60	1.09	7,600	4.98	2,372	43
Matanuska	157.212	14.59	1.99	2.29	6,142.37	2.15	4,795.3	96

10 KNOTS, 48-HOUR TEST.

Pocahontas	137.325	10.5	1.18	3.515	2,134	3.08	7,077	100
Matanuska	118.582	15.67	1.86	3.37	2,686.527	3.09	7,160.6	98

The board found that this sample of Matanuska coal tested is suitable in every respect for use in the naval service.

Appendix P.—SUMMARY OF REPORT ON TEST OF MATANUSKA COAL BY INTERIOR DEPARTMENT, BUREAU OF MINES, 1914.

[Subject: Report on test of Matanuska coal on U. S. S. *Maryland.*]

BUREAU OF MINES EXPERIMENT STATION,
Pittsburgh, Pa., December 17, 1914.

The DIRECTOR:

The following is Mr. Flagg's report upon the tests of Matanuska coal aboard the U. S. S. *Maryland:*

INSPECTION AND LOADING.

Upon the *Maryland's* arrival at Bremerton a visit was made to the coal dock where some 7,700 sacks of the coal were stored under cover. On account of the receipt of a letter from the Bureau of Steam Engineering, stating that preliminary tests at Annapolis indicated high ash content and instruction that the necessary preparation be given the coal, a preliminary inspection was made to gain some idea as to the quality of the coal. Rough determinations of the ash contents of the different-sized parts of a sample taken from six bags at random failed to show any excessive percentage of ash, so the coal was loaded onto the lighters and placed in the ship's bunkers.

During the loading of the lighters a shovelful of coal was taken from every fifth bag and retained for a sample. This sample (of about 3 tons) was worked over and one can retained. From the same sample a portion (about 600 pounds) was taken for a sizing test. The percentage of the different sizes, the analyses of the samples of the several sizes, and the analysis of the general sample are given in attached sheets.

SEVEN-DAY PORT TEST.

The port test was begun as soon as one lighter of coal had been taken on. The load during part of the test period was heavy but was carried throughout the test on one boiler. Fires were cleaned every 12 hours, by which time about 2 inches of clinker had formed. The clinker was medium weight, rather porous, and dark colored with small pieces of light-gray ash mixed in with the fused portion. The clinker stuck some to the bridge wall, but not enough to cause serious trouble, and did not stick to the grates at all. In the furnace the clinkers could be broken fairly easily; when cold it was brittle and easily broken.

During the port test the gas analyses showed 10 to 12 per cent CO_2 with probably three-tenths to four-tenths per cent CO. The effect was to carry fires 7 to 8 inches thick, but they were heavier much of the time, thus accounting in one way for the presence of CO.

The soot formed was comparatively free from tarry matter, and hence did not adhere to the tubes as much as does that from Pocahontas coal, although the amount of soot formed by the Matanuska coal was more than with Pocahontas.

The figures for the evaporation, on account of the difficulties incident to the measurement of the feed water, can only be considered approximate at best. The figures obtained during the port test showed an evaporation equal to or a little better than was obtained during the test with Pocahontas coal made by the *Maryland* in 1913.

On the last two days of the port test the use of screened coal was tried. The coal for this purpose was screened on the lighter alongside the dock. One day all of the coal remaining on a 4-mesh screen was used and on the other that which passed through the screen. The only trouble experienced with the finer coal was that the natural draft was not quite strong enough to maintain the required rate of combustion at all times.

20-KNOT TEST.

The excellent steaming properties of this coal were plainly shown in this test. For a time it looked as if it would be possible to make the turns for 20 knots without putting on the blowers, but it was not done. With about ¾-inch pressure of air in the firerooms, however, there was an abundance of steam and steam could be raised to the popping-off pressure at any minute. This condition obtained throughout the four-hour test, and at its close the fires were still in excellent steaming condition.

15-KNOT TEST.

For the 15-knot test 12 boilers were lit up, but soon after the test was started 2 of these were cut out, and later a third. During the remainder of the test the turns were kept up most of the time with 8 boilers working and the ninth banked. Difficulties in maintaining the desired steam pressure with the 8 boilers was experienced only at times of cleaning the fires, and then only when the fires were cleaned too soon after each other. For cruising at this speed it has been the practice to use 10 boilers with eastern coal.

10-KNOT TEST.

Six boilers were lit for this run, but one was banked almost at the start of the test and later it was cut out. About two and a half hours after the test started a second boiler was banked, and this was cut out when the test had been in progress nine hours. During the remainder of the test four boilers only were used, these furnishing plenty of steam to make the proper number of turns and keep the regular auxiliaries going. For this speed the practice has been to use six boilers for Pocahontas coal. So far as is known, the *Maryland* has never before made turns for 10 knots with only four boilers in use.

GENERAL.

The coal as stored on the dock was dry, but was wet on the lighters after they were placed alongside the ship. Neither on the dock nor in the bunkers was any tendency to heating noticed. The coal was almost entirely free from lumps, but for the most part, was not objectionably fine.

It is a very friable coal, has moderate coking tendency, and is excellent for steaming purposes. The volatile matter appears to be fairly easily driven off, but is not difficult to burn.

From the standpoint of smokelessness the coal is also very desirable. Under natural draft the stack observations ranged between No. 0 and No. 3 (Ringelmann chart), averaging somewhat above No. 2. Under forced draft during the four-hour run the smoke averaged about the same, but showed less of the heavier smoke. The smoke is somewhat less in density than that from Pocahontas and it is not as black.

Both officers and men cooperated heartily with the bureau's engineer throughout the test, and this cooperation was one factor contributing to the success of the tests.

Very truly, yours,

O. P. HOOD,
Chief Mechanical Engineer.

Appendix Q.—ANALYSES OF MATANUSKA COAL, COMPARED WITH OTHER COALS.

Analysis of Matanuska coal compared with analysis of other coals available on the Pacific coast.

[See U. S. Bureau of Mines Bulletin No. 76, Analyses of United States Coals Available for Export.]

Analysis.	Matanuska.	British Columbia.		Washington.		Australia.	Alabama.	Indiana and Illinois.
		High volatile.	Low volatile.	Pierce County.	King County.			
Volatile matter, "dry coal"	21.35	40.00	24.40	40.00	41.00	42.10	34 00	38.00
Fixed carbon, "dry coal"	68.25	47.50	61.10	49.00	47.00	51.90	59.00	53.00
Ash, "dry coal"	10.40	12.50	14.50	11.00	12.00	6.00	7.00	9.00
Sulphur, "dry coal"	.50	1.10	.50	.90	.80	.85	1.00	2.00
Moisture "as received"	3.00	2.70	1.70	3.00	.00	2.65	2.50	8.00
Heating value (B. t. u.), dry coal	139.25	127.90	131.25	133.50	124.00	141.45	140.50	130.00

Analysis.	Virginia, Kentucky, and Tennessee.	Virginia and West Virginia.		West Virginia gas coal.	Northern West Virginia, Maryland, and eastern Pennsylvania.		Western Pennsylvania.
		Pocohontas.	New River.		Low volatile.	High volatile.	
Volatile matter, "dry coal"	35.00	17.00	19.00	34.00	19.00	28.00	35.00
Fixed carbon, "dry coal"	56.50	76.50	76.00	57.50	73.00	64.00	55.50
Ash, "dry coal"	8.50	6.50	5.00	8.50	8.00	8.00	9.50
Sulphur, "dry coal"	.70	.65	.55	1.50	1.25	.70	1.25
Moisture "as received"	2.50	2.50	2.50	2.50	2.50	2.50	4.00
Heating value (B. t. u.), dry coal	141.00	147.00	149.00	140.00	143.50	142.50	136.50

Appendix R.—CONSUMPTION OF COAL AND COKE ON PACIFIC COAST.

Table showing consumption of coal and coke on Pacific coast (in short tons) in the years 1910 to 1914, inclusive.

[Prepared with the assistance of the U. S. Bureau of Mines.]

	1910		1911		1912		1913		1914	
	Coal.	Coke.	Coal.	Coke.	Coal.	Coke.	Coal.	Coke.	Coal.	Coke.
Alaska, imports[1]	65,986	30	79,083	.....	53,396	.....	60,600	.....	40,168	.....
Hawaii, imports	78,448	529	70,800	1,013	66,003	889	113,419	.....	100,837	400
California, imports	339,501	79,402	430,691	97,658	329,902	33,752	249,490	44,167	244,279	40,528
Oregon, imports	20,991	3,490	29,781	4,865	21,517	3,663	2,906	2,804	6,669	2,820
Washington, imports	92,606	1,120	91,058	1,502	74,960	1,427	60,421	599	38,439	987
Total (long tons)	597,532	84,571	701,413	105,038	545,778	39,731	486,836	47,570	430,392	44,735
Total (short tons)	669,236	94,720	785,583	117,642	611,271	44,498	545,256	53,278	482,039	50,103
In order to ascertain the actual coal consumption it is necessary to convert the amount of coke used into its coal equivalent; allow 1.51 tons of coal to 1 of coke	143,027	.....	177,639	.....	67,192	.....	80,449	.....	75,655	.....
Coal brought into California by railroad from New Mexico, Utah, and Wyoming (figures for other years not available)	.....	.....	.....	.....	.....	.....	363,123	.....	.....	.....
Production of coal[2] in:										
Washington	3,911,899	.....	3,572,815	.....	3,360,932	.....	3,877,891	.....	[3] 3,680,884	.....
California	11,164	.....	10,747	.....	10,978	.....	24,839	.....	[3] 14,432	.....
Oregon	67,533	.....	46,661	.....	41,637	.....	46,063	.....	[3] 50,473	.....
Coal arriving at Pacific coast ports from eastern States, by water[4]	[5] 113,417	.....	89,979	.....	136,740	.....	[6] 113,378	.....	[6] 113,378	.....
Total consumption	4,916,276	.....	4,683,424	.....	4,228,750	.....	5,050,999	.....	4,416,861	.....

[1] Bureau of Foreign and Domestic Commerce.
[2] From The Production of Coal in 1913, U. S. Geological Survey.
[3] Average of four preceding years.
[4] This is for San Francisco only. Figures for other ports not available. (From The Production of Coal in 1912, U. S. Geological Survey.)
[5] Includes coal bought for the Navy. The average annual amount of coal used by the Navy on the Pacific coast is 142,000 tons, which will probably be increased to 150,000 tons.
[6] Average for preceding years.

Appendix S.—COST OF COALS AT SAN FRANCISCO.

Cost of various grades of United States coals at San Francisco.

[Prepared with the assistance of the U. S. Bureau of Mines.]

	Pocahontas.		Utah.	Washington.	Colorado.	Wyoming.	Pennsylvania.	
	Maximum.	Minimum.					Maximum.	Minimum.
Price at Hampton Roads or Philadelphia	$2.90	$2.57						
Ocean freight	6.90	2.45					$6.90	$2.45
Selling price at mine, 1913			$1.65	$2.38	$1.52	$1.56	1.11	1.11
Railroad freight to San Francisco			5.15				[1] 1.18	[1] 1.18
Unloading charges	.16½	.16½	.05				.16½	.16½
Total	9.96½	5.18½	6.85	2.38	1.52	1.56	9.35½	4.90½

[1] The freight rate, as given by U. S. Bureau of Mines, is $1.18 to Baltimore and $1.25 to Philadelphia.

Table of comparative cost of coals laid down in San Francisco.

	Maximum.	Minimum.
Bering River coal via Cordova	$6.22½	$4.57½
Bering River coal via Controller Bay	5.71½	4.06½
Matanuska coal via Ship Creek	4.86½	3.88½
Matanuska coal via Portage Bay	5.44½	4.46½
Matanuska coal via Seward	5.97½	4.99½
Pocahontas coal via Hampton Roads and Philadelphia	9.96½	5.18½
Pennsylvania (Somerset County) coal via Baltimore	9.35½	4.90½
Utah coal	6.85	.....

Appendix T.—PRICE AT WHICH ALASKA COAL CAN BE LAID DOWN AT SAN FRANCISCO AND SEATTLE.

Price at which Alaska coal can be laid down in San Francisco and Seattle.

[See H. Doc. No. 876, 63d Cong.]

	Maximum.				Minimum.			
	Bureau of Mines mining cost estimate.		Mr. A. H. Storr's mining cost estimate.		Bureau of Mines mining cost estimate.		Mr. A. H. Storr's mining cost estimate.	
	Seattle.	San Francisco.	Seattle.	San Francisco.	Seattle.	San Francisco.	Seattle.	San Francisco.
Bering River coal via Cordova:								
Mining costs	$3.35	$3.35	$1.96	$1.96	$2.60	$2.60	$1.93	$1.93
Haulage to Cordova (including wharfage)[1]	.96	.96	.96	.96	.96	.96	.96	.96
Ocean freight	1.25	1.75	1.25	1.75	1.16	1.52	1.16	1.52
Unloading charge	.16½	.16½	.16½	.16½	.16½	.16½	.16½	.16½
Total	5.72½	6.22½	4.33½	4.83½	4.88½	5.24½	4.21½	4.57½
Bering River coal via Controller Bay:								
Mining costs	3.35	3.35	1.96	1.96	2.60	2.60	1.93	1.93
Haulage to Controller Bay (including wharfage)	.45	.45	.45	.45	.45	.45	.45	.45
Ocean freight	1.25	1.75	1.25	1.75	1.16	1.52	1.16	1.52
Unloading charge	.16½	.16½	.16½	.16½	.16½	.16½	.16½	.16½
Total	5.21½	5.71½	3.82½	4.32½	4.37½	4.73½	3.70½	4.06½
Matanuska coal via Ship Creek:								
Mining costs	2.00	2.00	.....	.....	1.25	1.25	.....	.....
Haulage to Ship Creek (including wharfage)	.95	.95	.....	.....	.95	.95	.....	.....
Ocean freight	1.25	1.75	.....	.....	1.16	1.52	.....	.....
Unloading charge	.16½	.16½	.....	.....	.16½	.16½	.....	.....
Total	4.36½	4.86½	.....	.....	3.52½	3.88½	.....	.....
Matanuska coal via Portage Bay:								
Mining costs	2.00	2.00	.....	.....	1.25	1.25	.....	.....
Haulage to Portage Bay (including wharfage)	1.53	1.53	.....	.....	1.53	1.53	.....	.....
Ocean freight	1.25	1.75	.....	.....	1.16	1.52	.....	.....
Unloading charge	.16½	.16½	.....	.....	.16½	.16½	.....	.....
Total	4.94½	5.44½	.....	.....	4.10½	4.46½	.....	.....
Matanuska coal via Seward:								
Mining costs	2.00	2.00	.....	.....	1.25	1.25	.....	.....
Haulage to Seward (including wharfage)	2.06	2.06	.....	.....	2.06	2.06	.....	.....
Ocean freight	1.25	1.75	.....	.....	1.16	1.52	.....	.....
Unloading charge	.16½	.16½	.....	.....	.16½	.16½	.....	.....
Total	5.47½	5.97½	.....	.....	4.63½	4.99½	.....	.....

[1] This is a rate of 1 cent per ton-mile. The rate given by the Bureau of Mines and by Mr. Storr is $1.42 maximum and 95 cents minimum. Included in this charge for haulage is 20 cents a ton for wharfage.

Average price received at mines for some United States coals in the years 1912 and 1913.

	Washington.	West Virginia.	Utah.	Colorado.	Pennsylvania.	Wyoming.
In the year—						
1912	$2.39	$0.94	$1.67	$1.49	$1.05	$1.58
1913	2.38	1.01	1.65	1.52	1.11	1.56

Appendix U.—STATISTICS OF COMMERCE AND INDUSTRIES OF THE TERRITORY OF ALASKA—VALUE OF THE OUTPUT OF SEA AND FUR PRODUCTS FROM ALASKA, 1868 TO 1913, INCLUSIVE.

TABLE No. 1.—*Statistics of commerce and industry of the Territory of Alaska.*[1]—*Value of the output of sea and fur products from Alaska, 1868 to 1913, inclusive.*

Year.	Sea and fur products.					
	Fur-seal skins.	Aquatic furs, except seals.[2]	Furs of land animals.	Walrus and whalebone products.	Fishery products.	Total.
1868	$708,734	$446,245	.....	.....	$306,638	$1,461,617
1869	653,118	446,245	.....	.....	276,630	1,375,993
1870	188,126	446,245	.....	.....	263,648	898,019
1871	1,584,986	437,555	$61,012	.....	175,268	2,258,821
1872	1,231,580	437,555	281,838	.....	157,300	2,108,273
1873	1,439,307	437,555	127,478	.....	101,200	2,105,540
1874	1,498,176	437,555	129,149	.....	116,182	2,181,062
1875	1,402,662	437,555	135,931	.....	137,646	2,113,794
1876	857,203	437,555	189,503	.....	231,201	1,715,462
1877	852,283	437,555	150,340	.....	122,700	1,563,878
1878	1,110,145	437,555	149,394	.....	184,422	1,881,506
1879	2,451,954	437,555	171,200	.....	246,399	3,307,108
1880	2,465,539	437,555	200,651	.....	179,200	3,282,946
1881	2,167,172	523,205	152,664	.....	168,008	3,011,049
1882	1,436,906	523,205	128,952	.....	257,111	2,346,174
1883	1,710,580	523,205	179,148	.....	467,692	2,880,625
1884	1,454,650	523,205	269,710	.....	500,145	2,747,710
1885	1,641,101	523,205	256,217	.....	527,679	2,948,202
1886	1,987,793	523,205	266,134	.....	746,186	3,523,318
1887	1,716,476	523,205	288,604	.....	917,007	3,445,292
1888	2,298,204	523,205	232,185	.....	1,447,478	4,501,072
1889	2,035,605	523,205	291,940	.....	2,352,652	5,203,402
1890	1,673,757	523,205	294,562	.....	2,360,500	4,852,024
1891	1,370,376	86,225	265,010	.....	2,756,742	4,478,353
1892	1,018,184	86,225	286,768	.....	1,784,510	3,175,687
1893	584,680	86,225	368,294	.....	2,323,308	3,380,507
1894	859,259	86,225	383,235	.....	2,486,852	3,815,571
1895	877,614	86,225	367,615	.....	2,123,107	3,454,561
1896	872,454	86,225	227,432	.....	3,120,844	4,306,955
1897	455,758	86,225	144,048	.....	3,132,976	3,819,007
1898	474,320	86,225	81,372	.....	3,429,529	4,071,446
1899	787,334	86,225	45,724	.....	3,749,110	4,668,393
1900	1,282,096	86,225	147,633	.....	5,303,294	6,819,248
1901	1,137,611	37,167	243,784	.....	6,685,262	8,103,824
1902	1,160,306	37,167	240,589	.....	8,310,304	9,748,366
1903	1,066,254	37,167	287,013	.....	7,505,245	8,895,679
1904	620,940	37,167	126,829	.....	6,458,585	7,243,521
1905	762,120	[3] 232,230	182,326	[4] $910,959	7,908,243	9,995,878
1906	756,757	30,369	108,049	196,838	8,524,372	9,616,385
1907	851,427	23,351	231,747	373,543	9,518,918	10,998,986
1908	822,970	31,828	323,480	148,382	11,140,161	12,466,821
1909	[5] 601,506	69,508	[6] 318,605	194,073	10,422,169	11,287,256
1910	[5] 473,207	111,790	[6] 318,605	136,791	12,650,191	13,371,979
1911	[5] 432,913	39,733	313,730	114,877	16,377,463	17,278,716
1912	[7] 141,290	.....	630,656	311,307	18,566,173	19 649,426
1913	[8] 83,667	.....	678,062	157,550	15,581,518	16,500,797
Total	52,060,100	12,496,063	9,659,008	2,544,320	182 100,768	258,860,259

[1] Statistics on Commerce, compiled by H. L. Muchemore.
[2] The following data of the Bureau of Fisheries with respect to aquatic furs have been distributed by annual averages: 1868–1870, $1,338,735; 1871–1880, $4,375,551; 1881–1890, $5,232,050; 1891–1900, $862,250 1901–1904, $148,668.
[3] Includes hair seal, 1868–1905, which can not be accurately distributed by years.
[4] 1868–1905.
[5] Product of Seal Islands only.
[6] Estimated.
[7] Includes $17,572 for furs from Pribilof Island foxes.
[8] Includes $22,209.91 for furs from Pribilof Island foxes.

Appendix V.—PRODUCTION OF GOLD, SILVER, AND COPPER IN ALASKA, 1880–1914.

TABLE No. 2.—*Production of gold, silver, and copper in Alaska, 1880–1914.*

Year.	Gold.		Silver.		Copper.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Commercial value.	Quantity (pounds).	Value.
1880	967	$20,000			3,933	$826
1881	1,935	40,000				
1882	7,256	150,000				
1883	14,566	301,000	10,320	$11,146		
1884	9,728	201,000				
1885	14,513	300,000				
1886	21,575	446,000				
1887	32,653	675,000				
1888	41,119	850,000	2,320	2,181		
1889	43,538	900,000	8,000	7,490		
1890	36,862	762,000	7,500	6,071		
1891	43,538	900,000	8,000	7,920		
1892	52,245	1,080,000	8,000	7,000		
1893	50,213	1,038,000	8,400	6,570		
1894	61,927	1,282,000	22,261	14,257		
1895	112,642	2,328,500	67,200	44,222		
1896	138,401	2,861,000	145,300	99,087		
1897	118,011	2,439,500	116,400	70,741		
1898	121,760	2,517,000	92,400	54,575		
1899	270,097	5,602,000	140,100	84,276		
1900	395,030	8,166,000	73,300	45,494		
1901	335,369	6,932,700	47,900	28,598	250,000	40,000
1902	400,709	8,283,400	92,000	48,590	360,000	41,400
1903	420,069	8,683,600	143,600	77,843	1,200,000	156,000
1904	443,115	9,160,000	198,700	114,934	2,043,586	275,676
1905	756,101	15,630,000	132,174	80,165	4,805,236	749,617
1906	1,066,030	22,036,794	203,500	136,345	5,871,811	1,133,260
1907	936,043	19,349,743	149,784	98,857	6,308,786	1,261,757
1908	933,290	19,292,818	135,672	71,906	4,585,362	605,267
1909	987,417	20,411,716	147,950	76,934	4,124,705	536,211
1910	780,131	16,126,749	157,850	85,239	4,241,689	538,695
1911	815,276	16,853,256	460,231	243,923	27,267,878	3,408,485
1912	829,435	17,145,951	515,186	316,839	29,230,491	4,823,031
1913	755,947	15,626,813	362,563	218,988	21,659,958	3,357,293
1914[1]	931,122	19,248,000	345,390	191,000	20,850,000	2,872,000
Total	11,979,530	247,640,540	3,703,001	2,251,191	132,803,435	19,799,518

[1] Preliminary estimate by U. S. Geological Survey.

Value of total mineral production of Alaska, 1880–1914.

BY YEARS.

1880–1890	$4,686,714	1903	$8,941,614
1891	916,920	1904	9,567,535
1892	1,096,000	1905	16,478,142
1893	1,048,570	1906	23,375,008
1894	1,305,257	1907	20,847,055
1895	2,386,722	1908	20,142,272
1896	2,980,087	1909	21,141,019
1897	2,538,241	1910	16,887,244
1898	2,585,575	1911	20,691,241
1899	5,703,076	1912	22,565,644
1900	8,238,294	1913	19,488,536
1901	7,007,398	1914	[1]22,596,000
1902	8,400,693	Total	271,579,457

BY SUBSTANCES.

Gold	$247,640,540
Silver (commercial value)	2,251,191
Copper	19,799,518
Coal	360,589
Marble, gypsum, tin, etc	1,527,619
Total	271,579,457

[1] Preliminary estimate.

Appendix W.—COPY OF THE REPORT OF THE COLLECTOR OF CUSTOMS, JUNEAU, ALASKA, ON GENERAL TRADE CONDITIONS OF THE TERRITORY FOR THE FISCAL YEAR 1914, AND COMPARATIVE STATEMENT OF TONNAGE SHIPPED FROM UNITED STATES TO ALASKAN PORTS, 1910–1914.

PORT OF JUNEAU, ALASKA, *January 25, 1915.*

This report of the general trade relations of the Territory shows satisfactory results and evidences a substantial growth. The increase of business over the previous year indicates that had Alaska not been materially affected by the general commercial depression, which retarded some important developments, reduced the price and production of copper and certain fish products, this year's transactions would have been the greatest in its history.

Imports and exports of foreign gold and silver, and most of the exports foreign, as shown below, are in transit. The other items cover the real trade of the country.

Commerce in Alaska.

	Calendar years.			
	1911	1912	1913	1914
IMPORTS.				
Merchandise from the United States	$15,169,149	$21,992,761	$21,689,690	$21,610,860
Merchandise from foreign ports	519,221	925,034	751,173	662,994
Gold and silver from foreign ports	3,520,170	3,840,546	4,320,985	3,576,090
Total imports	19,208,540	26,758,341	26,761,848	25,849,944
EXPORTS.				
Merchandise to the United States	19,318,859	24,793,886	22,252,942	25,427,873
Merchandise to foreign ports	1,174,393	1,452,955	1,141,660	1,006,518
Domestic gold and silver to the United States	14,699,694	16,031,705	12,959,266	14,729,905
Foreign gold and silver to the United States	3,353,361	3,704,173	4,306,591	3,450,400
Total exports	38,546,307	45,982,719	40,660,459	44,614,696
Grand total of imports and exports	57,754,847	72,741,060	67,422,307	70,464,640

The following table of Alaska's products entering into commerce shows these interesting features: The greatest export of canned salmon and a marked increase in fish oils, precious metals, and marble.

The value of fur shipments by mail, amounting to $182,084, was received too late to be shown in the table. This amount, added to the value shown below, gives the proper total.

Value of domestic merchandise and gold and silver shipped from Alaska to the United States.

Articles.	1911	1912	1913	1914
Copper ore and matte	$2,898,885	$4,904,715	$3,765,132	$3,365,342
Fish:				
Salmon, canned	13,136,980	15,551,794	13,349,438	17,906,215
Salmon, all other	502,134	907,242	1,074,483	750,512
All other fish and fish products	478,497	589,529	1,092,274	908,921
Fish fertilizers	63,439	41,662	53,657	51,463
Fish and whale oil	170,991	283,339	243,096	310,344
Furs	816,850	728,554	672,633	610,401
Gypsum	124,200	129,375	129,375	107,347
Marble	49,455	77,159	92,588	119,796
Tin ore and concentrates	41,830	90,831	72,734	71,400
Whalebone	20,551	18,012	80	.....
Other merchandise	852,758	1,000,261	1,188,834	1,226,132
Gold and silver [1]	14,699,694	16,031,705	12,959,266	14,729,905
Total	33,856,264	40,354,178	34,698,590	40,157,778

[1] *Gold and silver shipped to the United States.*

Judicial divisions.	1911	1912	1913	1914
First	$3,730,264	$4,040,858	$3,586,164	$4,177,069
Second	3,246,498	3,138,881	2,239,057	2,662,273
Third	404,861	734,507	592,008	1,491,248
Fourth	7,318,071	8,117,459	6,542,037	6,399,315
Total	14,699,694	16,031,705	12,959,266	14,729,905

Comparative statement of domestic merchandise and gold and silver shipped from Alaska to the United States for six years previous to 1911.

1905	$22,065,733	1908	$30,299,789
1906	30,759,159	1909	31,686,118
1907	27,682,263	1910	28,660,277

The following table of passenger movement indicates the travel, by regularly established routes, to and from the District and the Yukon Territory. Tourists and cannery employees bound for remote places are not included.

The Eagle and Dawson movement shows the local frontier travel, which must not be considered with the general account, as the greater number of those passengers arrived or departed from Ketchikan or St. Michael and have been accounted for in their returns.

	1912	1913	1914
Arrivals from the United States and British Columbia:			
Southeastern, southern, and western Alaska	20,645	21,963	23,822
Nome, St. Michael, and Bering Sea	2,067	1,795	1,491
Total	22,712	23,758	25,313
Departures to the United States and British Columbia:			
Southeastern, southern, and western Alaska	18,502	21,376	22,645
Nome, St. Michael, and Bering Sea	3,375	2,974	1,893
Total	21,877	24,350	24,538
Arrivals at Eagle from Dawson	594	914	785
Departures from Eagle to Dawson	935	1,448	1,102
Total	1,529	2,362	1,887

An indication of the industrial progress of the Territory is found in the quantity of merchandise imported from the States. Developments and operations in the southeastern division were very active during the first half of the year, and had they continued a very interesting return would have been made. The result, however, shows a satisfactory increase over the previous year. The southern division makes some improvement, but the divisions where the great gold placers are located have met with the natural decline due to the exhaustion of the more easily exploited deposits.

Comparative statement showing value of merchandise shipped from the United States to the different divisions of Alaska.

Divisions.	1910	1911	1912	1913	1914
Southeastern Alaska	$5,236,325	$5,492,416	$9,769,224	$9,725,472	$11,075,532
Southern Alaska	4,538,225	3,246,464	4,321,689	3,979,178	4,039,705
Bering Sea, etc	4,150,679	2,919,456	4,168,934	4,200,520	3,516,983
St. Michael and Yukon River	3,506,359	3,510,813	3,732,914	3,784,520	2,978,640
Total	17,431,588	15,169,149	21,992,761	21,689,690	21,610,860

The tables following give the value of merchandise shipped to Alaska from the United States for the year 1914 segregated as to place of consignment, with comparative statements for five years, and general customs transactions by ports.

J. F. PUGH, *Collector of Customs.*

Value of merchandise shipped from the United States to southeastern Alaska.

Beauclerc	$28,471	Klawack	$48,583
Burnett Inlet	32,650	Klukwan	1,918
Cape Edwards	35,269	Lake Bay	41,650
Chatham	66,069	Loring	126,655
Chichagof	75,900	Metlakatla	17,490
Chilkoot	42,988	Moira Sound	35,399
Chomly	94,788	Naket Inlet	14,296
Craig	63,320	Petersburg	246,556
Dolomi	10,415	Point Ellis	38,246
Douglas	495,432	Point Ward	43,255
Dundas	43,082	Porcupine	2,534
Excursion Inlet	141,770	Port Armstrong	21,343
Funter Bay	93,414	Quadra	52,136
Georges Inlet	13,418	Roe Point	65,439
Glacier	46,389	Rose Inlet	88,531
Gypsum	18,694	Santa Ana	45,406
Hadley	31,730	Shakan	61,707
Haines	274,273	Sitka	167,451
Hawk Inlet	50,574	Skagway	390,561
Hecata	22,105	Sulzer	17,498
Hidden Inlet	47,397	Taku	80,452
Holbrook	10,237	Tee Harbor	49,778
Hoonah	71,202	Tenakee	14,944
Hunters Bay	50,527	Tokeen	30,320
Hydaburg	13,958	Treadwell	1,002,372
Jualin	73,640	Tyee	5,954
Juneau	4,017,710	Wards Cove	44,419
Kake	41,955	Warm Chuck	3,069
Karheen	40,400	Waterfall	45,684
Kasaan	92,933	Wrangell	355,558
Kensington	10,086	Yes Bay	82,596
Ketchikan	1,548,228		
Killisnoo	34,755	Total	11,075,532

Comparative statement of principal places in southeastern Alaska.

Name.	1910	1911	1912	1913	1914
Douglas	$362,290	$357,467	$484,798	$473,901	$495,432
Haines	274,953	248,700	343,205	290,894	274,273
Juneau and Thane	745,822	655,182	1,417,910	3,240,681	4,017,710
Ketchikan	564,894	711,144	1,454,783	1,250,878	1,548,228
Loring	116,284	159,463	142,307	120,521	126,655
Petersburg	236,627	238,075	353,379	341,170	246,556
Sitka	212,000	171,138	143,654	218,101	167,451
Skagway	275,738	225,785	709,529	369,799	390,561
Treadwell	1,321,739	1,061,545	890,453	1,024,027	1,002,372
Wrangell	245,820	248,627	526,727	419,761	355,558
All other places	880,158	1,415,290	3,302,479	1,975,739	2,450,736
Total	5,236,325	5,492,416	9,769,224	9,725,472	11,075,532

Value of merchandise shipped from the United States to southern Alaska from Yakutat to Unalaska and Dutch Harbor.

Afognak	$19,549	Orca	$70,369
Akutan	21,966	Ouzinkie	1,485
Alitak	41,997	Pavlof	6,973
Chignik	150,294	Pirate Cove	22,895
Chisana	17,534	Portage Bay	7,916
Chitina	130,273	Port Graham	47,291
Cold Bay	7,519	Port Wells	16,257
Cooks Inlet	60,563	Sand Point	23,501
Copper Center	4,875	Sannak	8,639
Cordova	783,834	Seldovia	52,278
Ellamar	88,450	Seward	302,888
Hope	31,106	Ship Creek	26,880
Illiama	13,833	Strelna	2,532
Karluk	77,823	Susitna	32,366
Katalla	24,062	Unalaska	51,599
Kenai	115,623	Unga	73,720
Kennecott	115,729	Uyak	60,392
King Cove	120,714	Valdez	658,302
Knik	237,472	Yakataga	2,665
Kodiak	113,433	Yakutat	86,121
Latouche	205,550		
McCarthy	97,719	Total	4,039,705
Northwest Harbor	4,718		

Comparative statement of principal places in southern Alaska.

Name.	1910	1911	1912	1913	1914
Chignik	$319,298	$307,273	$488,681	$277,339	$150,294
Chitina	8,602	63,502	106,740	109,553	130,273
Cordova	2,071,007	775,981	888,155	832,067	783,834
Ellamar	34,862	25,960	42,584	86,453	88,351
Karluk	129,511	174,480	178,151	130,763	77,833
Katalla	85,395	73,803	71,412	47,861	24,062
Kodiak	81,436	69,390	123,586	111,489	125,841
Latouche	66,823	66,687	83,715	106,323	217,958
Orca	55,687	57,163	69,066	69,989	70,369
Seward	230,206	230,095	278,061	231,704	315,296
Uyak	30,164	42,665	87,958	104,019	60,392
Valdez	805,295	685,203	563,609	716,944	670,710
All other places	619,939	624,262	1,339,971	1,154,674	1,436,074
Total	4,538,225	3,246,464	4,321,689	3,979,178	4,039,705

Value of merchandise shipped from the United States to all places on Bering Sea and Arctic Ocean except St. Michael.

Bethel	$55,303	Naknek	$1,782
Bristol Bay	1,227,787	Nome	926,808
Candle	46,799	Nushagak	350,823
Cape York	37,286	Point Barrow	34,047
Council	47,506	Point Hope	3,726
Cripple Creek	13,486	Port Moller	103,521
Deering	37,445	Pribilof Islands	36,066
Dickson	12,246	Shungnak	13,332
Gambell	1,171	Sinuk	1,236
Golovin	76,024	Solomon	93,354
Icy Cape	1,512	Tacotna	28,449
Igloo	1,162	Teller	60,803
Keewalik	12,826	Unalakleet	9,215
Koggiung	201,136		
Kotzebue	79,936	Total	3,516,983
Kuskokwim	2,196		

Comparative statement of principal places, Bering Sea and Arctic Ocean.

Name.	1910	1911	1912	1913	1914
Bristol Bay	$1,833,579	$1,153,359	$1,820,829	$1,774,890	$1,227,787
Candle	79,054	53,534	68,346	70,925	46,799
Deering	41,827	23,710	90,891	66,967	37,445
Golovin	77,010	43,899	77,010	109,759	76,024
Kvichak	63,870	127,901	63,870	220,208	.....
Nome	1,145,758	1,060,993	1,279,396	1,223,599	926,808
Teller and Port Clarence	13,363	48,450	65,877	41,232	60,803
All other places	896,218	407,610	702,715	692,940	1,141,317
Total	4,150,679	2,919,456	4,168,934	4,200,520	3,516,983

Value of merchandise shipped from the United States to St. Michael and the Yukon Basin.

Anvik	$17,297	Louden	$3,290
Beaver	1,444	Marshall City	1,874
Bettles	26,974	Minto	2,846
Chatinika	4,690	Mountain Village	1,809
Chena	14,984	Nenana	4,041
Circle	74,986	Nulato	12,776
Dikeman	47,304	Ophir	4,354
Eagle	65,142	Rampart	19,523
Fairbanks	1,304,556	Ruby	169,262
Fort Yukon	20,039	Russian Mission	4,462
Forty Mile River	3,812	St. Michael	387,492
Hamilton	7,959	Stevens Village	4,882
Holy Cross	23,426	Tanana	199,716
Hot Springs	158,308	Tofty	7,571
Iditarod	323,343	Tolovana	9,080
Innoko	14,324	Yakakaket	3,184
Kaltag	6,740		
Kokrines	1,578	Total	2,978,640
Koyukuk	25,572		

Comparative statement of principal places in Yukon district.

Name.	1910	1911	1912	1913	1914
Chena	$120,799	$120,589	$159,217	$101,788	$14,984
Eagle	75,198	25,672	47,687	33,364	65,142
Fairbanks	1,096,550	895,101	1,391,025	1,280,506	1,304,556
Hot Springs	51,529	83,830	67,032	115,490	158,308
Iditarod	241,179	523,234	286,770	482,189	323,343
Ruby	.....	13,784	201,444	289,750	169,262
St. Michael	1,544,101	1,458,616	989,968	854,373	387,492
Tanana	170,926	186,422	213,509	241,317	199,716
All other places	206,077	203,565	376,262	385,743	355,837
Total	3,506,359	3,510,813	3,732,914	3,784,520	2,978,640

Statement of number and tonnage of vessels entered and cleared for the year ended Dec. 31.

DOMESTIC TRADE.

Port.	1913				1914			
	Entered.		Cleared.		Entered.		Cleared.	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
Ketchikan	721	390,698	652	371,996	736	424,630	709	400,630
Wrangell	14	10,373	7	2,218	5	2,251	8	2,386
Juneau	13	19,685	16	17,878	10	27,729	14	23,189
Skagway	9	8,532	19	19,635	.....	.....	3	4,396
St. Michael	8	10,475	8	8,749	9	12,369	1	2,112
Nome	21	35,461	25	45,011	15	25,670	20	30,343
Unalaska	13	8,902	7	609	12	5,827	15	5,425
Cordova	5	7,153	15	22,705	6	9,941	17	27,534
Sulzer	8	2,787	21	16,016	12	6,866	23	13,668
Total	812	493,066	770	504,817	805	515,283	810	509,683

FOREIGN TRADE.

Ketchikan	234	157,480	204	123,812	253	148,925	228	129,356
Wrangell	25	9,296	20	2,881	33	2,020	35	2,451
Juneau	3	4,382	1	1,985	2	2,090	.....	.....
Skagway	1	1,377	.....	.....	1	1,495	.....	.....
Eagle	71	31,665	74	32,373	52	19,508	52	19,988
St. Michael	.....	.....	1	78	.....	.....	.....	.....
Nome	22	8,297	18	6,004	25	1,754	22	3,782
Unalaska	2	4,729	1	55	4	4,466	2	476
Cordova	.....	.....	.....	.....	1	2,080	.....	.....
Sulzer	7	280	8	427	7	65	10	797
Total	365	217,506	327	167,617	378	182,403	349	156,850

Recapitulation of customs business for the year ended Dec. 31, 1914.

Port.	Vessels entered.		Vessels cleared.		Entries taken.	Vessels documented.	Total vessels entered.	Total vessels cleared.
	Foreign.	Coastwise.	Foreign.	Coastwise.				
Ketchikan	253	736	228	709	122	183	989	937
Wrangell	33	5	35	8	118	84	38	43
Juneau	2	10	.....	14	93	152	12	14
Skagway	1	.....	.....	3	567	.....	1	3
Eagle	52	.....	52	.....	102	3	52	52
St. Michael	.....	9	.....	1	2	24	9	1
Nome	25	15	22	20	44	62	40	42
Unalaska	4	12	2	15	6	30	16	17
Cordova	1	6	.....	17	.....	15	7	17
Sulzer	7	12	10	23	1	23	19	33
Fortymile	.....	.....	.....	.....	34	.....	.....	.....
Total	378	805	349	810	1,089	576	1,185	1,159

List of officers and employees in the Alaska customs service.

Name.	Title.	Station.
J. F. Pugh	Collector	Juneau.
C. D. Garfield	Special deputy collector	Do.
M. S. Whittier	Deputy collector and inspector	Do.
D. A. Meek	Stenographer and typewriter	Do.
Geo. M. Simpkins	Deputy collector and inspector	Do.
Milson S. Dobbs	Deputy collector in charge	Ketchikan.
Geo. W. Woodruff	Deputy collector and inspector	Do.
F. E. Bronson	Deputy collector in charge	Wrangell.
Fred J. Vandewall	....do	Skagway.
G. G. Miller	Deputy collector and inspector	Do.
J. J. Hillard	Deputy collector in charge	Eagle.
John L. Abrams	....do	Fortymile.
John Elden	Deputy collector and inspector	Do.
Edwin R. Stivers	Deputy collector in charge	St. Michael.
R. W. J. Reed	....do	Nome.
N. E. Bolshanin	....do	Unalaska.
Geo. Kennedy	....do	Cordova.
Chas. A. Sulzer	....do	Sulzer.

Comparative statement of tonnage (domestic merchandise) shipped from the United States to principal points in the Yukon Basin, 1909–1913.

[Based on valuation of $86.50 per ton.]

Name.	1910	1911	1912	1913	1914
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Chena	1,395	1,392	1,841	1,176	173
Circle	586	364	755	607	.....
Eagle	869	296	551	385	753
Fairbanks	12,660	10,330	16,080	14,803	15,081
Hot Springs	592	968	775	1,335	1,830
Rampart	160	38	99	249	.....
Iditarod	.....	.....	331	5,574	3,738
Ruby	.....	.....	2,329	3,349	1,957
St. Michael	17,850	16,850	11,444	9,877	4,479
Tanana	1,975	2,150	2,468	2,789	2,310
All others	4,420	8,150	4,350	4,459	4,114
Total	40,507	40,548	41,023	44,603	34,425

Appendix X.—METEOROLOGICAL DATA AT VARIOUS PLACES IN ALASKA.

[U. S. Department of Agriculture, Weather Bureau.]

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
VALDEZ (FORT LISCUM) OFFICIAL.[1]													
Temperature:													
Average	19	22	26	33	42	50	52	50	45	36	26	24	35
Highest	45	45	54	53	71	79	82	80	84	57	47	45	84
Lowest	−14	−12	− 8	2	25	30	32	30	17	10	0	−13	−14
Precipitation:													
Average	7.01	5.08	6.00	3.58	4.27	2.45	5.03	7.90	9.29	8.98	5.88	8.70	74.17
Greatest	16.58	13.60	9.80	6.94	10.11	6.14	11.25	16.20	16.64	18.20	10.67	13.53	91.31
Least	1.75	.52	.10	.81	.68	.24	2.19	2.59	4.11	2.83	.59	2.93	52.92
Unmelted snow:													
Average	83.5	55.6	69.5	31.2	0.6	0	0	0	1.4	11.3	41.9	80.6	375.6
Greatest	165.5	171.2	117.0	94.0	5.0	0	0	0	13.5	32.6	134.3	157.8	572.4
Wind direction:													
Prevailing	NE.	NE.	NE.	NE.	SE.	SW.	W.	SW.	SW.	SW.	NE.	NE.	NE.

[1] Temperature data expressed in degrees Fahrenheit; precipitation in hundredths of an inch; snow in tenths of an inch.

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
SEWARD.													
Temperature:													
Average	19	27	31	36	44	49	54	54	49	39	31	26	38
Highest	43	44	49	65	75	84	83	85	84	64	49	45	85
Lowest	−11	−12	− 7	10	26	32	40	33	27	11	9	− 5	−12
Precipitation:													
Average	2.01	4.92	3.34	3.70	3.54	1.83	2.66	5.16	7.18	8.62	7.54	10.00	60.50
Greatest	3.32	10.43	5.77	6.24	4.47	4.39	4.82	13.04	13.91	9.73	20.99	12.80	109.91
Least	.52	.47	2.30	.55	1.43	.05	.72	2.45	3.28	5.72	.37	4.91	38.81
Unmelted snow:													
Average	18.0	13.9	8.0	4.0	0	0	0	0	0	0.5	3.8	17.2	65.4
Greatest	30.0	32.0	24.0	21.0	0	0	0	0	0	2.0	10.0	32.0	76.0
Wind direction:													
Prevailing	N.	N.	N.	S.	S.	S.	S.	S.	S.	N.	N.	N.	N-S.
SUNRISE.													
Temperature:													
Average	10	19	25	33	43	50	54	52	44	34	23	18	34
Highest	44	51	58	60	76	79	76	78	72	59	51	48	79
Lowest	−29	−27	−23	− 4	23	27	34	28	17	2	−15	−26	−29
Precipitation:													
Average	2.44	2.70	1.78	2.74	1.95	1.04	2.00	2.98	3.34	4.91	4.61	4.91	35.40
Greatest	7.03	6.01	3.63	5.08	6.12	2.46	4.62	5.02	5.00	9.35	9.47	8.48	40.66
Least	.54	.13	.28	.68	.84	,07	1.05	1.40	1.54	2.56	.40	2.30	22.82
Unmelted snow:													
Average	23.7	14.9	16.4	9.4	T.	0	0	0	1.0	5.2	16.8	27.4	114.8
Greatest	63.7	33.4	33.9	21.6	T.	0	0	0	5.5	14.2	32.2	50.4	158.2
Wind direction:													
Prevailing	S.	S.	S.	N.	N.	N.	N.	N.	N.	N.	S.	S.	N.
FAIRBANKS.[1]													
Temperature:													
Average	−20	− 4	8	26	48	58	60	54	42	26	1	− 7	24
Highest	34	43	47	60	81	88	86	85	80	67	46	43	88
Lowest	−65	−57	−56	−32	17	31	30	19	11	−21	−54	−59	−65
Precipitation:													
Average	.88	.29	.65	.25	.48	1.55	1.60	1.89	1.37	.72	.98	.78	11.44
Greatest	3.30	.86	2.42	.66	1.22	3.25	2.82	3.70	3.58	2.46	4.65	1.23	18.73
Least	.05	.04	.02	T.	.16	.44	.46	.71	.25	.10	.24	.15	7.98
Unmelted snow:													
Average	9.5	4.0	9.1	1.4	T.	0	0	0	0.6	6.0	5.0	9.2	44.8
Greatest	33.0	8.6	24.2	5.0	0.2	0	0	0	1.5	24.4	12.0	18.0	99.9
Wind direction:													
Prevailing	W.	W.	E.	E.	E.	W.	W.	SW.	E.	E.	W.	W.	W.
COPPER CENTER.[1]													
Temperature:													
Average	−11	1	14	29	44	53	55	52	42	28	5	− 3	26
Highest	49	49	49	64	80	96	88	87	80	66	49	50	96
Lowest	−74	−55	−48	−26	17	21	22	20	3	−26	−46	−53	−74
Precipitation:													
Average	.63	.49	.24	.08	.43	.86	1.56	1.10	1.22	.96	.76	.54	9.07
Greatest	1.25	1.73	.69	.36	.92	1.60	3.43	2.72	3.79	2.02	2.35	.97	9.38
Least	.10	.05	.02	.00	.13	.20	.56	.50	.25	.25	.10	.20	6.46
Unmelted snow:													
Average	7.5	3.4	2.7	0.7	T.	0	0	0	0.7	7.6	6.6	7.7	36.9
Greatest	17.2	6.0	9.2	3.0	0.5	0	0	0	5.2	15.2	15.0	15.9	51.5
Wind direction:													
Prevailing	NW.	NW.	SE.	SE.	SE.	SE.	SE.	SE.	SE.	SE.	NW.	NW.	SE.
TANANA.													
Temperature:													
Average	−16	− 5	8	23	45	58	59	52	39	22	− 2	−13	22
Highest	35	41	53	63	81	90	89	90	78	67	37	30	90
Lowest	−76	−68	−57	−39	11	26	32	18	3	−27	−55	−68	−76
Precipitation:													
Average	.77	.62	.61	.20	.95	.73	2.01	2.42	1.18	1.04	.79	.65	11.97
Greatest	3.16	1.63	1.16	.77	1.57	2.06	4.90	3.80	2.32	4.40	3.42	1.61	13.79
Least	0.5	.08	T.	00	.16	.20	.96	1.113	.35	.22	.03	T.	7.85
Unmelted snow:													
Average	7.4	7.6	7.4	2.6	0.1	0	0	0	0.8	6.5	3.8	9.4	4.562
Greatest	15.1	18.0	17.8	7.7	1.0	0	0	0	4.0	12.2	10.5	38.8	6.4
Wind direction:													
Prevailing	N.	NE.	NE.	E.	NE.	SW.	SW.	SW.	NE.	NE.	NE.	NE.	NE.

[1] Precipitation includes rain, water from snow melted by observer, sleet, etc.

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
RAMPART.													
Temperature:													
Average	−22	− 8	6	22	46	59	60	55	41	22	− 2	−12	22
Highest	38	42	51	65	85	94	94	96	85	58	37	30	96
Lowest	−68	−64	−45	−31	15	27	32	23	7	−28	−56	−59	−68
Precipitation:													
Average	.75	.54	.54	.25	.63	1.12	1.37	1.59	1.19	.83	.61	.83	.85
Greatest	1.17	2.20	1.17	.75	1.04	3.03	2.29	3.38	2.52	1.23	1.43	1.99	15.53
Least	.13	.08	.17	.01	.20	.34	.43	.12	.36	.39	.21	.32	5.32
Unmelted snow:													
Average	7.8	6.8	6.9	3.1	0.5	0	0	0	2.0	7.7	6.2	9.0	50.0
Greatest	15.6	28.0	12.8	8.9	2.8	0	0	0	7.8	14.4	14.5	20.2	71.0
Wind direcion:													
Prevailing	N.	NE.	NE.	NE.	N.	SW.	SW.	SW.	N.	N.	N.	NE.	N.
CORDOVA.													
Temperature:													
Average	29	33	34	38	45	50	55	55	50	42	34	31	41
Highest	52	58	62	71	70	74	78	73	78	72	60	47	78
Lowest	5	4	1	15	28	34	42	40	32	27	12	5	1
Precipitation:													
Average	5.84	9.75	10.72	7.90	8.97	7.12	6.92	11.72	22.35	16.92	8.16	12.10	128.47
Greatest	10.00	13.69	16.79	14,79	20,29	14.63	12.77	23.16	49.63	24.88	17.19	21.47	190.83
Least	2.68	7.50	3.98	4.02	3.86	. 74	4.37	6.39	11.27	9.04	1.69	9.33	111.85
Unmelted snow:													
Average	34.6	34.9	24.9	28.6	0.3	0	0	0	T.	0.7	15.4	42.4	181.8
Greatest	96.5	61.0	48.0	43.0	1.5	0	0	0	T.	2.0	25.8	59.2	259.0
Wind direction:													
Prevailing	N.	NE.	E.	NE.	SE.	SW.	E.	SE.	NE.	SE.	SE.	NE.	NE. SE.
KENAI.													
Temperature:													
Average	10	18	24	34	44	50	54	54	46	32	21	13	33
Highest	49	48	59	68	79	87	82	78	75	60	46	45	87
Lowest	−42	−46	−34	−17	20	28	27	25	11	− 5	−27	−43	−46
Precipitation:													
Average	.65	1.01	.83	.65	.85	.92	2.16	3.39	3.06	2.29	2.12	1.02	18.96
Greatest	1.47	4.92	1.98	1.43	2.98	2.31	5.49	6.26	10.00	5.42	14.59	2.11	22.51
Least	.29	.11	.02	.04	T.	.06	.32	1.04	.78	.41	.32	.19	13.50
Unmelted snow:													
Average	7.3	10.0	7.0	3.3	T.	0	0	0	0	4.5	9.4	10.1	51.6
Greatest	13.0	35.8	14.0	9.5	T.	0	0	0	0	11.0	17.22	23.5	87.7
Wind direction:													
Prevailing	N.	N.	N.	N.	SW.	SW.	SW.	SW.	N.	N.	N.	N.	N.
TYONOK.													
Temperature:													
Average	12	19	25	35	45	53	57	58	49	36	25	18	36
Highest	38	49	58	59	74	91	82	76	79	61	47	49	91
Lowest	−27	−25	−9	−1	22	33	38	31	22	5	−13	−21	−27
Precipitation:													
Average	1.68	.98	.91	.99	.46	1.05	2.66	4.41	3.82	3.37	1.27	1.21	22.81
Greatest	3.08	3.91	1.66	2.38	1.05	2.86	6.39	5.77	6.56	4.96	3.10	1.86	28.29
Least	.58	.20	.45	.24	.04	.25	.92	2.72	.92	1.15	.45	.53	20.17
Unmelted snow:													
Average	16.9	12.6	13.2	10.4	.7	0	0	0	0	5.2	9.9	13.2	82.1
Greatest	24.2	46.0	33.0	31.0	4.0	0	0	0	0	14.2	15.5	28.5	104.9
Wind direction:													
Prevailing	NW.	N.	.	SE.	S.	S.	S.	S.	S.	N.	NW.	NW.	S.
KETCHENSTOCK.													
Temperature:													
Average	−24	−13	4	21	43	52	54	50	34	22	− 2	−15	19
Highest	33	34	41	59	76	83	83	78	64	52	34	30	83
Lowest	−64	−54	−57	−40	11	21	26	17	0	−30	−43	−58	−64
Precipitation:													
Average	.28	.13	.18	.25	1.13	1.91	2.20	1.86	1.03	1.50	.40	.58	11.45
Greatest	.90	.30	.41	.40	1.80	3.66	3.39	2.51	2.16	5.00	.90	2.00	18.13
Least	.00	.00	.05	T.	T.	.83	.40	.94	.49	.30	.03	.20	9.01
Unmelted snow:													
Average	4.9	3.3	1.4	3.0	2.0	0	0	0	1.3	6.5	4.3	2.9	29.6
Greatest	12.0	12.0	4.0	5.0	12.0	0	0	0	4.0	11.8	9.0	3.5	39.0
Wind direction:													
Prevailing	Calm appeared most frequently in observer's record.												

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
TEIKHELL.													
Temperature:													
Average	− 4	5	18	32	45	54	56	53	42	32	13	0	29
Highest	36	42	50	58	81	92	100	103	75	52	45	38	103
Lowest	−45	−36	−28	−18	15	25	28	24	11	9	−23	−31	−45
Precipitation:													
Average	1.28	.83	.65	.36	.36	.92	3.37	1.44	1.11	2.40	3.11	1.88	17.71
Greatest	2.50	1.81	1.87	.75	.80	1.39	8.20	2.00	1.41	2.90	4.90	2.95	17.91
Least	.37	.20	.05	.04	T.	.68	1.05	.72	.62	1.48	.90	.36	14.64
Unmelted snow:													
Average	13.2	9.3	11.4	3.2	T.	T.	0	0	1.1	9.5	21.0	18.9	87.6
Greatest	25.0	21.4	26.2	7.2	T.	T.	0	0	2.5	11.0	35.8	28.0	113.2
Wind direction:													
Prevailing	N.	N.	N.	S.	S.	S.	S.	S.	S.	N.	N.	N.	S.
CHICKALOON.[1]													
1910.													
Temperature:													
Mean monthly	.....	.....	27	28	45	51	58	54	47	30	15	8	.....
Highest	.....	.....	50	54	78	71	84	79	84	55	34	34	.....
Lowest	.....	.....	−12	−8	24	26	38	30	21	−7	−5	−25	.....
Precipitation	.....	.....	.....	.20	.12	1.19	1.42	.49	1.46	.71	.27	.51	.....
Unmelted snow	.....	.....	7.0	T.	T.	0	0	0	0	5.0	6.5	9.0	.....
Wind direction	.....	.....	NE.	NE.	SW.	SW.	SW.	SW.	SW.	SE.	SE.	E.	.....
1911.													
Temperature:													
Mean monthly	4	14	14	28	41	50	55	55	.....	.....	.....	.....	.....
Highest	29	42	43	51	58	77	77	80	.....	.....	.....	.....	.....
Lowest	−33	−28	−27	−12	17	27	41	29	.....	.....	.....	.....	.....
Precipitation	.84	2.47	1.15	.19	.13	.85	2.41	1.17	.....	.....	.....	.....	.....
Unmelted snow	13.0	24.0	18.0	1.5	T.	0	0	0	.....	.....	.....	.....	.....
Wind direction	NE.	SW.	NW.	NE.	SW.	SW.	SW.	SW.	.....	.....	.....	.....	.....
MILLER HOUSE.													
Temperature:													
Average	−14	1	12	25	43	53	59	54	44	32	4	−7	25
Highest	34	65	68	70	75	91	90	89	88	81	66	43	91
Lowest	−44	−50	−42	−22	16	31	33	24	3	−14	−40	−46	−50
Precipitation[2]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Unmelted snow[2]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wind direction[2]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
CIRCLE.													
Temperature:													
Average	−12	−18	− 1	21	42	57	61	55	38	15	−10	−11	20
Highest	36	28	38	64	78	84	96	90	84	46	41	32	96
Lowest	−61	−55	−55	−32	6	32	35	19	2	−18	−52	−53	−61
Precipitation:													
Average	.80	.32	.61	.84	.68	.88	1.89	1.85	1.86	.78	.42	.72	11.65
Greatest	1.53	0.57	1.60	1.45	1.45	2.24	3.25	2.79	2.21	1.15	.75	1.11	.....
Least	.20	.10	.20	.15	.29	.20	.87	1.02	1.65	.40	.10	.40	.....
Unmelted snow:													
Average	5.6	3.6	6.0	5.9	3.1	0	0	0	11.5	7.2	4.8	8.0	55.7
Greatest	9.2	7.8	16.0	11.0	12.5	0	0	0	15.5	11.5	8.5	10.5	.....
Wind direction:													
Prevailing	W.	NW.	W.	W.	W.	S.	S.	NW.	NW.	NW.	NW.	NW.	NW.
EAGLE.													
Temperature:													
Average	−17	−5	10	26	45	57	59	52	41	24	2	−11	24
Highest	41	45	56	64	84	92	91	86	79	68	48	40	92
Lowest	−75	−74	−56	−38	10	24	29	18	2	−28	−52	−68	−75
Precipitation:													
Average	.48	.37	.52	.43	.85	1.40	1.99	2.27	1.36	.99	.51	.51	11.68
Greatest	1.45	1.23	2.19	1.19	2.87	2.35	2.56	4.73	3.38	2.96	1.27	1.10	13.46
Least	.06	T.	.0	0	.28	.37	1.06	.95	.01	.13	.21	.07	8.28
Unmelted snow:													
Average	7.2	2.6	4.9	3.4	.1	0	0	0.5	1.4	9.2	6.9	9.6	45.8
Greatest	20.0	8.3	11.4	14.7	.6	0	0	4.2	6.1	30.0	14.5	20.4	57.3
Wind direction:													
Prevailing	SE.	S.	SE.	SE.	SE.	SE.	NW.	NW.	SE.	SE.	E.	SE.	SE.

[1] Chickaloon is located near Knik, 148° 50′ W. and 61° 40′ N. Record began March, 1910, and ended August, 1911.
[2] No record.

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
DAWSON, CANADA.													
Temperature:													
Average	−21	−14	4	30	47	58	61	55	42	24	−1	−9	23
Highest	21	25	52	67	85	90	95	86	78	68	46	38	95
Lowest	−68	−53	−42	−30	17	27	35	26	8	−22	−48	−51	−68
Precipitation:													
Average	.82	.70	.38	.57	.77	.92	1.85	1.68	1.84	1.11	.79	1.20	12.63
Greatest	1.73	1.35	.88	.94	1.06	1.71	3.32	2.51	3.52	2.25	1.55	1.85	15.37
Least	.23	.20	0	.23	.39	.25	1.11	1.08	1.01	.36	.24	.65	11.28
Unmelted snow [1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wind direction [1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

[1] No record.

Appendix Y.—REPORT AND ANALYSIS OF EXPENDITURES AND REPORT OF MONEYS RECEIVED, TO JAN. 31, 1915.

Report and analysis of expenditures made from the appropriation "Construction and operation of railroads in Alaska" to Jan. 31, 1915, inclusive.

Equipment of camps and engineering parties:		
Purchase of surveying instruments	$10,384.92	
Tents and tarpaulins	4,435.92	
Stoves, tools, utensils, and supplies	6,967.93	
Guns and ammunition	357.18	
Cameras and photographic supplies	1,308.35	
Blankets and other bedding	3,411.00	
Drugs and surgical supplies	645.76	
Freight	2,576.05	
		$30,087.11
Pack animals and outfits:		
Purchase of pack animals	22,227.00	
Freight—		
Railroads in United States	196.48	
Ocean steamers	2,922.00	
River steamers, Alaska	1,491.35	
Railroads in Alaska (included in ocean freights)	----------	
Lighterage and wharfage	119.00	
Hire of pack animals	5,084.62	
Purchase of pack outfits	4,850.86	
Supplies for outfits	259.89	
Freight	208.72	
		37,359.92
Purchase, maintenance, and hire of boats:		
Purchase of boats—		
Launches	3,249.14	
Other boats	1,006.65	
Repairs and alterations	1,227.52	
Gasoline, oils, and supplies	3,814.10	
Hire of launches	5,107.75	
Berthing boats for winter	126.50	
Lumber to build boats during winter	241.08	
Freight	545.80	
		15,318.54
Salaries and wages:		
Commissioners and office force—		
Field season	17,609.89	
Before and after field season	12,368.60	
Field employees, including temporary service after close of field season	157,083.96	
Employees in Alaska, left in custody of live stock and other property after close of field season	1,850.00	
		188,912.45

Stationery, office and drafting supplies:		
Purchase of stationery and technical supplies for both office and field, including typewriters and certain instruments not segregated	$5,157.34	
Advertising	50.92	
Freight	344.42	
		$5,552.68
Subsistence:		
Primary cost of provisions	35,606.98	
Freight	4,682.76	
Meals and lodging—		
United States	2,417.98	
Alaska	5,212.14	
Other subsistence items, and incidental expenses of travel	1,012.80	
Per diem in lieu of subsistence	7,469.00	
		56,401.66
Subsistence and care of pack animals:		
Hay	13,274.94	
Freight	1,511.93	
Oats and other grain	4,587.26	
Freight	281.17	
Salt	49.93	
Stabling and care of pack animals—		
During field season	579.85	
Contracts for wintering	2,021.84	
Medical service and medicine	119.80	
Shoeing	606.25	
Shoes and nails	418.33	
Freight	27.92	
		23,479.22
Storage and rent of offices and warehouses:		
In Alaska	443.39	
In United States	947.10	
		1,390.49
Telephone and telegraph:		
Telephone	251.87	
Telegraph	224.57	
		476.44
Passenger transportation:		
Railroads, United States—		
Railroad fares	2,526.23	
Pullman fares	647.40	
Trolley	4.90	
Railroads in Alaska	3,144.05	
Fares for water travel—		
Ocean steamers	17,209.95	
River steamers, Alaska	6,660.60	
Launches, Alaska	693.90	
Automobile, Alaska	204.00	
Automobile, United States	128.00	
(Purchasing horses, etc.)		
		31,219.03
Furniture:		
Purchase of furniture	651.25	
Rent of furniture	39.21	
		690.46
Medical attendance and hospital bills		296.85
Drayage:		
In Alaska	207.00	
In United States	65.75	
		272.73
Material for camp buildings:		
Lumber	505.68	
Millwork, hardware, and other material	456.23	
Freight	485.54	
		1,447.45
Total		392,905.02

Report of moneys received May 1, 1914, to Jan. 31, 1915.

Date received.	Name of payee.	In payment for.	Amount.
Oct. 2, 1914	J. H. Wilson	Condemned bacon	$51.75
Oct. 10, 1914	T. R. Wilson	Poling boat	5.00
Oct. 15, 1914	Herbert Tozier	Stove, etc	7.00
Nov. 30, 1914	B. H. Barndollar	Disallowances	5.60
Dec. 4, 1914	Wm. Hughes & Co.	Rent of barn	9.00
Dec. 11, 1914	Various persons	Horses sold at auction	36.00
Jan. 5, 1915	Copper River & Northwestern Ry.	Unused ticket	15.50
Jan. 19, 1915	Wm. Hughes & Co.	Rent of barn	18.00
Jan. 25, 1915	White Pass & Yukon Route.	Refund on freight	10.00
Do	Alaska Steamship Co.	Unused ticket	220.00
	Total receipts		377.85

Appendix Z.—DETAILED ESTIMATES OF COST.

ESTIMATE No. 1.—PORTAGE BAY TO FAIRBANKS VIA SUSITNA VALLEY AND BRANCH LINES.

RECAPITULATION.

1. Terminal docks and yards at Portage Bay (approximately)	$150,000.00
2. Construction of line, Portage Bay to Fairbanks	25,517,866.00
3. Ship Creek branch	123,635.00
4. Ship Creek terminals	25,000.00
5. Matanuska coal branch	1,766,684.00
Grand total	27,583,185.00

Estimates do not include rolling stock.

Summary of estimates on main line, mile 1 to mile 418.351, Portage Bay to Fairbanks.

(See following pages for details.)

1. Tunnel No. 1, mile 3, near Portage Bay, 13,005 linear feet, at $100	$1,300,500.00
2. Tunnel No. 2, mile 6, in Bear Valley, 4,960 linear feet, at $85	421,600.00
3. Mile 1 to 18.13, Portage Bay to Kern Creek, 14.73 miles, railroad construction, at $49,355 per mile	727,006.00
4. Mile 18.13 to 46.21, Kern Creek to 1½ miles south of Potter Creek, 28.08 miles, at $110,157 per mile	3,093,214.00
5. Mile 46.21 to 64.65, 1½ miles south of Potter Creek to Ship Creek Summit, 18.44 miles, at $49,461 per mile	912,102.00
6. Mile 64.65 to mile 103.73, Ship Creek Summit to Knik wagon road, 39.08 miles, at $40,981 per mile	1,601,670.00
7. Mile 103.73 to 185.48, Knik wagon road to Talkeetna, 81.74 miles, at $28,603 per mile	2,338,034.00
8. Mile 185.48 to 256.33, Talkeetna to Broad Pass, 70.85 miles, at $51,990 per mile	3,683,360.00
9. Mile 256.33 to 307.87, Broad Pass to Healy Fork, 51.544 miles, at $57,519 per mile	2,964,755.00
10. Mile 307.87 to 338.12, Healy Fork to Thirty-Mile Road House, 30.25 miles, at $40,716 per mile	1,231,648.00
11. Mile 338.12 to 362.22, Thirty-Mile Road House to Tanana River, 23.47 miles, at $23,890 per mile	560,689.00
12. Mile 362.1, Tanana River bridge at Nenana	615,635.00
13. Mile 362.22 to 411.16, Tanana River to Tanana Valley Railroad (via Goldstream), 48.94 miles, at $34,224 per mile	1,674,938.00
14. Mile 411.16 to 418.351, Tanana Valley Railroad to Fairbanks, 7.722 miles, at $20,000 per mile	154,440.00
15. Four Divisional terminal yards, at $75,000	300,000.00
	21,579,591.00

Add 10 per cent for engineering, supervision, and contingencies	$2,157,959.00
Total construction cost	23,737,550.00
Add interest charges at 3 per cent for one-half period of construction (2½ years)	1,780,316.00
Grand total	25,517,866.00

Estimate of tunnels in section mile 1 to mile 18.13.

TUNNELS.

Tunnel No. 1, mile 3, 13,005 linear feet, at $100	$1,300,500.00
Tunnel No. 2, mile 6, 4,960 linear feet, at $85	421,600.00
Total	1,722,100.00

Estimates do not include rolling stock.

Estimate of section (Portage Bay to Kern Creek), mile 0 to mile 18.13.

1. Real estate and right of way		$400.00
2. Clearing, 74 acres, at $75		5,550.00
3. Grubbing, 11 acres, at $150		1,650.00
4. Excavation:		
(a) Common, 3,810 cubic yards, at 40 cents	$1,524.00	
(b) Solid rock, 114,685 cubic yards, at $1.25	143,356.00	
		144,880.00
5. Borrow:		
(a) Common, 161,144 cubic yards, at 40 cents	64,458.00	
(b) Solid rock, 44,968 cubic yards, at $1.25	56,210.00	
		120,668.00
6. Overhaul, 11,493,146 cubic yards, at 1 cent per 100 cubic yards		114,931.00
7. Wooden bridges:		
(a) Piling, 76,057 linear feet, at 35 cents	26,620.00	
(b) Lumber, 1,535,300 feet, b. m., at $40 M	61,412.00	
(c) Iron, 194,565 pounds, at 8 cents	15,565.00	
		103,597.00
8. Timber culverts:		
(a) Logs, 22,785 linear feet, at 20 cents	4,557.00	
(b) Lumber, 800 feet, b. m., at $40 M	32.00	
(c) Iron, 8,337 pounds, at 8 cents	667.00	
		5,256.00
9. Riprap, 114 cubic yards, at $2		228.00
10. Track, permanent, 95,706 linear feet, at $1.78		170,357.00
11. Telegraph line, 18.13 miles, at $250		4,533.00
12. Station buildings, three, at $2,500		7,500.00
13. Section houses, one, at $1,500		1,500.00
14. Water stations, one, at $4,000		4,000.00
15. Passing tracks and station ground (three tracks):		
(a) Clearing 300 feet, extra width, 1,000 feet long, 3 by 7 acres, at $100	$2,100.00	
(b) Grading, 3 by 3,400 feet, 10,200 feet, 1.93 miles, at $10,000	19,300.00	
(c) Permanent track, 10,200 linear feet, at $1.78	18,156.00	
(d) Turnouts, 6 No. 7 switches, at $250	1,500.00	
		41,056.00
16. Miscellaneous structures		900.00
Total		727,006.00
Average for 14.73 miles		49,355.00

Estimate of section, mile 18.13 to mile 46.21 (Kern Creek to mile 46.21) 28.08 miles.

1. Real estate and right of way		$600.00
2. Clearing, 310 acres at $75		23,250.00
3. Excavation:		
(a) Common excavation, 631,172 cubic yards, at 40 cents	$252,469.00	
(b) Loose rock, 3,863 cubic yards, at 80 cents	3,090.00	
(c) Solid rock, 1,024,847 cubic yards, at $1.25	1,281,059.00	
		1,536,618.00
4. Borrow:		
(a) Common excavation, 44,939 cubic yards, at 40 cents	17,976.00	
(b) Solid rock, 220,287 cubic yards, at $1.25	275,350.00	
		293,335.00
5. Overhaul, 5,076,457 cubic yards, at 1 cent per 100 feet		50,765.00
6. Wooden bridges:		
(a) Piling, 21,758 linear feet, at 35 cents	$7,615.00	
(b) Lumber, 457,600 feet b. m., at $40 M	18,304.00	
(c) Iron, 190,741 pounds at 8 cents	15,259.00	
		41,178.00
7. Steel bridges:		
(a) Steel, 1,575,400 pounds, at 8½ cents	133,909.00	
(b) Lumber, 173,800 feet b. m., at $40 M	6,952.00	
		140,861.00
8. Excavation in foundations, wet excavation, 4,820 cubic yards, at $3		14,460.00
9. Grillage piles, 6,900 linear feet, at 35 cents		2,415.00
10. Concrete:		
(a) 1,400 cubic yards class A, at $15	21,000.00	
(b) 4,120 cubic yards class B, at $12	49,440.00	
		70,440.00
11. Timber culverts:		
(a) logs, 185,970 linear feet at 20 cents	37,194.00	
(b) Lumber, 7,800 feet b. m. at $40 M	312.00	
(c) Iron, 69,749 pounds, at 8 cents	5,580.00	
		43,086.00
12. Snowsheds, 8,855 linear feet, at $60		531,300.00
13. Riprap (loose), 1,111 cubic yards, at $2		2,222.00
14. Track, permanent, 148,290 linear feet, at $1.78		263,956.00
15. Telegraph line, 28.08 miles, at $250		7,020.00
16. Station buildings, 4, at $2,500		10,000.00
17. Section houses, 1, at $1,500		1,500.00
18. Water stations, 1, at $4,000		4,000.00
19. Passing tracks and stations grounds (4 tracks):		
(a) Clearing, 300 feet extra width, 1,000 feet long, 4 by 7 acres, at $100	2,800.00	
(b) Grading, 4 by 3,400 feet=13,600 linear feet=2.58 miles, at $10,000	25,800.00	
(c) Permanent track, 13,600 linear feet, at $1.78	24,208.00	
(d) Turnouts, 8 No. 7 switches, at $250	2,000.00	
		54,808.00
20. Miscellaneous structures		1,400.00
Total		3,093,214.00
Average for 28.08 miles (per mile)		110,157.00

Estimate of section, mile 46.21 to mile 64.65 (18.44 miles).

1. Real estate and right of way	$1,000.00
2. Clearing 443 acres, at $75	33,225.00
3. Grubbing 45 acres, at $150	6,750.00

4. Excavation:		
(a) Common excavation, 196,869 cubic yards, at 40 cents	$78,748.00	
(b) Loose rock, 1,695 cubic yards, at 80 cents	1,356.00	
(c) Solid rock, 217,460 cubic yards, at $1.25	271,825.00	
		$351,929.00
5. Borrow:		
(a) Common excavation, 493,476 cubic yards, at 40 cents	197,390.00	
(b) Solid rock, 13,692 cubic yards, at $1.25	17,115.00	
		214,505.00
6. Overhaul, 3,461,409 cubic yards, at 1 cent per 100 feet		34,614.00
7. Wooden bridges:		
(a) Piles, 24,094 linear feet, at 35 cents	$8,433.00	
(b) Lumber, 331,200 feet b. m., at $40 M	13,248.00	
(c) Iron, 75,730 pounds, at 8 cents	6,058.00	
		27,739.00
8. Concrete, 390 cubic yards, class A, at $15		5,850.00
9. Timber, culverts and bulkheads:		
(a) Logs, 11,204 linear feet, at 20 cents	2,241.00	
(b) Lumber, 13,300 feet b. m., at $40 M	532.00	
(c) Iron, 7,196 pounds, at 8 cents	576.00	
		3,349.00
10. Riprap, 180 cubic yards, at $2		360.00
11. Track, permanent, 97,369 linear feet, at $1.78		173,317.00
12. Telegraph line, 18.441 miles, at $250		4,610.00
13. Station buildings, 3, at $2,500		7,500.00
14. Section houses, 1, at $1,500		1,500.00
15. Water stations, 1, at $4,000		4,000.00
16. Passing tracks:		
(a) Clearing, 300 feet extra width, 1,000 feet long, at each passing track, 3 by 7 acres, at $100	2,100.00	
(b) Grading, 3 by 3,400 feet=10,200 linear feet=1.93 miles, at $10,000	19,300.00	
(c) Permanent track, 10,200 linear feet, at $1.77	18,054.00	
(d) Turnouts, 6 No. 7 switches, at $250	1,500.00	
		40,954.00
17. Miscellaneous structures		900.00
Total		912,102.00
Average for 18.44 miles (per mile)		49,461.00

Estimate of section, mile 64.65 to mile 103.73 (39.08 miles).

1. Real estate and right of way		$1,000.00
2. Clearing 863 acres, at $75		64,725.00
3. Grubbing 52 acres, at $150		7,800.00
4. Excavation:		
(a) Common excavation, 553,375 cubic yards, at 40 cents	$221,350.00	
(b) Loose rock, 35,000 cubic yards, at 80 cents	28,000.00	
(c) Solid rock, 218,455 cubic yards, at $1.25	273,069.00	
		522,419.00
5. Borrow:		
(a) Common excavation, 404,140 cubic yards, at 40 cents	161,656.00	
(b) Loose rock, 54,500 cubic yards, at 80 cents	43,600.00	
(c) Solid rock, 73,850 cubic yards, at $1.25	92,313.00	
		297,569.00
6. Overhaul, 2,147,645 cubic yards, at 1 cent per 100 feet		21,476.00

7. Wooden bridges:		
(*a*) Piling, 81,034 linear feet, at 35 cents	$28,362.00	
(*b*) Lumber, 2,030,400 feet b. m. at $40 M	81,216.00	
(*c*) Iron, 657,259 pounds, at 8 cents	52,581.00	
		$162,159.00
8. Steel bridges:		
(*a*) Steel, 350,460 pounds, at 8½ cents	29,789.00	
(*b*) Lumber, 18,200 feet b. m., at $40 M	728.00	
		30,517.00
9. Excavation in foundations, 500 cubic yards wet excavation, at $3		1,500.00
10. Concrete, 780 cubic yards, class B, $12		9,360.00
11. Timber culverts:		
(*a*) Logs, 51,756 linear feet, at 20 cents	$10,351.00	
(*b*) Iron, 18,793 pounds, at 8 cents	1,503.00	
		11,854.00
12. Cribs:		
(*a*) 2,600 linear feet logs, at 20 cents	520.00	
(*b*) Iron, 680 pounds, at 8 cents	54.00	
		574.00
13. Riprap, 960 cubic yards, at $2		1,920.00
14. Track, 206,360 linear feet, at $1.77		365,257.00
15. Telegraph line, 39 miles, at $250		9,750.00
16. Station buildings, 5 (7-mile intervals), at $2,500		12,500.00
17. Section houses, 2, at $1,500		3,000.00
18. Water stations, 2, at $4,000		8,000.00
19. Passing tracks and station grounds:		
(*a*) Clearing 300 feet extra width, 1,000 feet long, at each passing track, 5 by 7 acres, at $100 per acre	$3,500.00	
(*b*) Grading 5 by 3,400 feet=3.22 miles, at $10,000	32,200.00	
(*c*) Permanent track, 17,000 linear feet, at $1.77	30,090.00	
(*d*) Turnouts, 10 No. 7 switches, at $250	2,500.00	
		68,290.00
20. Miscellaneous structures		2,000.00
Total		1,601,670.00
Average for 39.08 miles, per mile		40,981.00

Estimate of section, mile 103.74 to mile 185.48 (81.74 miles).

1. Real estate and right of way		$1,000.00
2. Clearing, 1,700 acres, at $75		127,500.00
3. Grubbing, 75 acres, at $150		11,250.00
4. Excavations:		
(*a*) Common excavation, 826,500 cubic yards, at 45 cents	$371,925.00	
(*b*) Loose rock, 394,900 cubic yards, at 80 cents	315,920.00	
(*c*) Solid rock, 75,000 cubic yards, at $1.40	105,000.00	
		792,845.00
5. Borrow:		
(*a*) Common excavation, 409,800 cubic yards, at 45 cents	184,410.00	
(*b*) Loose rock, 32,600 cubic yards, at 80 cents	26,080.00	
		210,490.00
6. Overhaul, 4,968,000 cubic yards, at 1 cent per 100 feet		49,680.00
7. Wooden bridges:		
(*a*) Piling, 65,676 linear feet, at 35 cents	$22,987.00	
(*b*) Lumber, 2,227,000 feet b. m., at $40 M	89,080.00	
(*c*) Iron, 701,600 pounds, at 8 cents	56,128.00	
		168,195.00

8. Excavations in foundations, 3,283 cubic yards, at $2		$6,566.00
9. Timber culverts and bulkheads:		
(a) 128,424 linear feet logs, at 20 cents	$25,685.00	
(b) 45,606 pounds iron, at 8 cents	3,649.00	
		29,334.00
10. Riprap, 300 cubic yards, at $2		600.00
11. Track, permanent, 431,600 linear feet, at $1.814		782,922.00
12. Telegraph lines, 82 miles, at $250		20,500.00
13. Station buildings, 12, at $2,500		30,000.00
14. Section houses, 4, at $1,500		6,000.00
15. Water stations, 4, at $4,000		16,000.00
16. Passing track and station grounds:		
(a) Clearing, 300 feet extra width, 1,000 feet long, 12 by 7 acres, at $100	8,400.00	
(b) Grading, 12 by 1,500 feet=3.4 miles, at $10,000 per mile	34,000.00	
(c) Permanent track, 18,000 linear feet, at $1.814	32,652.00	
(d) Turnouts, 2+ switches, complete, at $250	6,000.00	
		81,052.00
17. Miscellaneous structures		4,100.00
Total		2,338,034.00
Average for 81.74 miles (per mile)		28,603.00

Estimate of section, mile 185.48 to mile 256.33 (70.85 miles).

1. Real estate and right of way		$1,000.00
2. Clearing 1,462 acres, at $75		109,650.00
3. Grubbing 148 acres, at $150		22,200.00
4. Excavation:		
(a) Common excavation, 1,158,921 cubic yards, at 75 cents	$869,191.00	
(b) Loose rock, 18,154 cubic yards, at 85 cents	15,431.00	
(c) Solid rock, 271,533 cubic yards, at $1.50	407,300.00	
		1,291,922.00
5. Borrow, common excavation, 191,795 cubic yards, at 75 cents		143,846.00
6. Overhaul, 1,311,000 cubic yards, at 1 cent per 100 feet		13,110.00
7. Tunnels:		
(a) Lined, 200 linear feet, at $140	$28,000.00	
(b) Unlined, 2,400 linear feet, at $90	216,000.00	
		244,000.00
8. Wooden bridges:		
(a) Piles, 76,580 linear feet, at 40 cents	30,632.00	
(b) Lumber, 2,213,000 feet b. m., at $45 M	99,585.00	
(c) Iron, 307,320 pounds, at 8½ cents	26,122.00	
		156,339.00
9. Steel bridges:		
(a) Steel, 7,096,940 pounds, at 9 cents	638,725.00	
(b) Lumber, 756,000 feet b. m., at $45 M	34,020.00	
		672,745.00
10. Excavation in foundations, 10,060 cubic yards, wet excavation, at $3		30,180.00
11. Grillage piles, 29,000 linear feet, at 40 cents		11,600.00
12. Concrete:		
(a) Class A, 2,362 cubic yards, at $16	$37,792.00	
(b) Class B, 7,088 cubic yards, at $13	92,144.00	
		129,936.00
13. Timber culverts:		
(a) Logs, 186,978 linear feet, at 25 cents	46,745.00	
(b) Iron, 68,427 pounds, at 8½ cents	5,816.00	
		52,561.00
14. Cribs, 7,800 linear feet logs, at 25 cents		1,950.00
15. Riprap, 2,876 cubic yards, at $2		5,752.00
16. Permanent track, 374,075 linear feet, at $1.83		684,557.00

17. Telegraph line, 374,075 linear feet, 70.847 miles, at $250		$17,712.00
18. Station buildings, 10 (7-mile intervals), at $2,500		25,000.00
19. Section houses, 3, at $1,500		4,500.00
20. Water stations, 3, at $4,000		12,000.00
21. Passing tracks and station grounds (10 tracks at 7-mile intervals):		
(a) Clearing, 300 feet extra width, 1,000 feet long, 10 by 7 acres, at $100	$7,000.00	
(b) Grading, 10 by 1,000 feet=10,000 feet of track=1.9 miles, at $10,000	19,000.00	
(c) Permanent track, 10,000 linear feet, at $1.83	18,300.00	
(d) Turnouts, 20 No. 7 turnouts, complete, at $250	5,000.00	
		49,300.00
22. Miscellaneous structures		3,500.00
Total		3,683,360.00
Average for 70.85 miles (per mile)		51,990.00

Estimate of section, mile 256.33 to mile 307.87 (51.54 miles).

1. Real estate and right of way		$1,000.00
2. Clearing, 959 acres, at $75		71,925.00
3. Grubbing, 297 acres, at $150		44,550.00
4. Excavations:		
(a) Common excavation, 392,971 cubic yards, at 80 cents	$314,377.00	
(b) Loose rock, 55,965 cubic yards, at 85 cents	47,570.00	
(c) Solid rock, 110,745 cubic yards, at $1.50	166,118.00	
		528,065.00
5. Borrow:		
(a) Common excavation, 714,396 cubic yards, at 80 cents	571,517.00	
(b) Loose rock, 10,150 cubic yards, at 85 cents	8,628.00	
		580,145.00
6. Overhaul, 105,800 cubic yards, at 1 cent per 100 feet		1,058.00
7. Wooden bridges:		
(a) Piling, 54,620 linear feet, at 40 cents	$21,848.00	
(b) Lumber, 1,997,470 feet b. m., at $45 M	89,886.00	
(c) Iron, 282,180 pounds, at 8½ cents	23,985.00	
		135,719.00
8. Steel bridges:		
(a) Steel, 8,331,050 pounds, at 9 cents	749,795.00	
(b) Lumber, 559,900 feet b. m., at $45 M	25,196.00	
		774,991.00
9. Excavation in foundations:		
(a) 5,800 cubic yards wet, at $3	17,400.00	
(b) 10,820 cubic yards dry, at $2	21,640.00	
		39,040.00
10. Grillage piles, 23,500 linear feet, at 40 cents		9,400.00
11. Concrete:		
2,127 cubic yards, class A, at $16	$34,032.00	
6,383 cubic yards, class B, at $13	82,979.00	
		117,011.00
12. Timber culverts:		
(a) Logs, 121,502 linear feet, at 25 cents	30,376.00	
(b) Lumber, 31,870 feet b. m., at $45 M	1,434.00	
(c) Iron, 48,962 pounds, at 8½ cents	4,162.00	
		35,972.00
13. Cribs:		
(a) Logs, 82,397 linear feet, at 25 cents	20,599.00	
(b) Iron, 21,350 pounds, at 8½ cents	1,815.00	
(c) Rock filling, 2,110 cubic yards, at $2	4,220.00	
		26,634.00

14. Riprap, 9,178 cubic yards, at $2		$18,356.00
15. Track, permanent, 272,152 linear feet, at $1.85		503,481.00
16. Telegraph line, 51.5 miles, at $250		12,875.00
17. Station buildings, 7, at $2,500		17,500.00
18. Section houses, 2, at $1,500		3,000.00
19. Water stations, 2, at $4,000		8,000.00
20. Passing tracks:		
(a) Extra clearing, 300 feet by 1,000 feet, 7 by 7 acres, at $75	$3,675.00	
(b) Extra grading, 7 by 1,000 feet = 1⅓ miles, at $10,000	13,333.00	
(c) Permanent track, 7,000 linear feet, at $1.85	12,950.00	
(d) Turnouts, 14, at $250	3,500.00	
		33,458.00
21. Miscellaneous structures		2,575.00
Total		2,964,755.00
Average for 51.544 miles		57,519.00

Estimate of section, mile 307.87 to mile 338.12 (30.25 miles).

1. Real estate and right of way		$1,000.00
2. Clearing, 460 acres, at $75		34,500.00
3. Grubbing, 27 acres, at $150		4,050.00
4. Excavation:		
(a) Common excavation, 359,165 cubic yards, at 75 cents	$269,374.00	
(b) Loose rock, 96,280 cubic yards, at 85 cents	81,838.00	
(c) Solid rock, 25,100 cubic yards, at $1.50	37,650.00	
		388,862.00
5. Borrow:		
(a) Common excavation, 344,520 cubic yards, at 75 cents (25 per cent added in big cuts for slides)	258,390.00	
(b) Loose rock, 29,240 cubic yards, at 85 cents	24,854.00	
		283,244.00
6. Overhaul, 467,000 cubic yards, at 1 cent per 100 feet		4,670.00
7. Wooden bridges:		
(a) Piling, 33,870 linear feet, at 40 cents	$13,548.00	
(b) Lumber, 559,700 feet b. m., at $45 M	25,186.00	
(c) Iron, 70,490 pounds, at 8½ cents	5,992.00	
		44,726.00
8. Steel bridges:		
(a) 827,00 pounds, at 9 cents	74,430.00	
(b) Lumber, 194,600 feet b. m., at $45 M	8,757.00	
		83,187.00
9. Excavation in foundation, 2,400 cubic yards, at $3		7,200.00
10. Concrete:		
380 cubic yards, class A, at $16	$6,080.00	
1,129 cubic yards, class B, at $13	14,677.00	
		20,757.00
11. Timber culverts:		
Logs, 43,623 linear feet, at 25 cents	10,906.00	
Piling, 600 linear feet, at 40 cents	240.00	
Lumber, 9,499 feet b. m., at $45 M	427.00	
Iron, 17,442 pounds, at 8½ cents	1,483.00	
		13,056.00
12. Cribs:		
29,920 linear feet logs, at 25 cents	7,480.00	
17,600 pounds iron, at 8½ cents	1,496.00	
		8,976.00
13. Riprap, 1,760 cubic yards, at $2		3,520.00
14. Permanent track, 159,730 linear feet, at $1.86		297,098.00

15. Telegraph line, 30.25 miles, at $250		$7,562.00
16. Station buildings, 4 (7-mile intervals), at $2,500		10,000.00
17. Section houses, 1 section house at water station		1,500.00
18. Water stations, 1, at $4,000		4,000.00
19. Passing tracks and station grounds:		
(a) Clearing, 300 feet extra width 1,000 feet long=4 by 7 acres, at $100	$2,800.00	
(b) Grading (included in above estimate).		
(c) Permanent track, 4 sidings 1,000 feet long=4,000 linear feet, at $1.86	7,440.00	
(d) Turnouts, 8, at $250	2,000.00	
		12,240.00
20. Miscellaneous structures		1,500.00
Total		1,231,648.00
Average for 30.25 miles (per mile)		40,716.00

Estimate of section along east bank of Nenana River (mile 338.12 to mile 362.22), 24.10 miles (including bridges.)

1. Real estate and right of way		$1,000.00
2. Clearing 200 feet, 550 acres, at $75		41,250.00
3. Grubbing, 78 acres, at $150		11,700.00
4. Grading and borrow, 275,494 cubic yards, common excavation, at 50 cents		137,747.00
5. Overhaul, 2,013,000 cubic yards, at 1 cent per 100 feet		20,130.00
6. Wooden bridges:		
(a) 28,473 linear feet piling, at 40 cents	$11,389.00	
(b) 820,300 feet b. m., at $45 M	36,914.00	
(c) 225,832 iron, at 8½ cents	19,196.00	
		67,499.00
7. Timber culverts:		
(a) Logs, 2,415 linear feet, at 25 cents	604.00	
(b) Iron, 828 pounds, at 8½ cents	70.00	
		674.00
8. Riprap, 2,570 cubic yards, at $2		5,140.00
9. Track, 127,223 linear feet, at $1.88		239,179.00
10. Telegraph line, 127,223 linear feet, = 24.1 miles, at $300		7,230.00
11. Station buildings, 3, at $2,500		7,500.00
12. Section house, 1, at $1,500		1,500.00
13. Water station, 1, at $4,000		4,000.00
14. Passing tracks and station grounds (3 tracks at 7-mile intervals):		
(a) Clearing 300 feet extra width, 1,000 feet long, 3 by 7 acres, at $100	$2,100.00	
(b) Grading, 3 by 1,000 feet = 3,000 feet track = 0.57 mile, at $10,000	5,700.00	
(c) Permanent track, 3,000 linear feet, at $1.88	5,640.00	
(d) Turnouts, 6 No. 7 turnouts complete, at $250	1,500.00	
		14,940.00
15. Miscellaneous structures		1,200.00
Total		560,689.00
Average per mile for 23.47 miles		23,890.00

Estimate bridge crossing, Tanana River (mile 362.1).

37,027 linear feet piling, at 40 cents	$14,811.00
557,200 feet b. m. lumber, at $45 M	25,074.00
65,980 pounds iron, at 8½ cents	5,608.00
4,381,350 pounds steel, at 9 cents	394,322.00
880,000 feet b. m. lumber, at $45 M	39,600.00
8,100 cubic yards wet excavation, at $3	24,300.00
43,800 linear feet grillage piles, at 40 cents	17,520.00
1,500 cubic yards class A concrete, at $16	24,000.00
4,800 cubic yards class B concrete, at $13	62,400.00
4,000 cubic yards riprap, at $2	8,000.00
Total	**615,635.00**

Estimate of section from north end of steel bridge at Tanana River crossing to Fairbanks via Goldstream (mile 362.22 to mile 411.16), 48.94 miles.

1. Real estate and right of way		$10,000.00
2. Clearing, 384 acres, at $75		28,800.00
3. Grubbing, 46 acres, at $150		6,900.00
4. Excavation:		
(a) Common excavation, 624,991 cubic yards, at 75 cents	$468,743.00	
(b) Loose rock, 50,000 cubic yards, at 85 cents	42,500.00	
(c) Solid rock, 71,300 cubic yards, at $1.50	106,950.00	
		618,193.00
5. Borrow, common excavation, 482,224 cubic yards, at 50 cents		241,112.00
6. Overhaul, 2,523,000 cubic yards, at 1 cent 100 feet		25,230.00
7. Wooden bridges:		
(a) Piling, 39,945 linear feet, at 40 cents	$15,978.00	
(b) Lumber, 1,598,400 feet b. m., at $45 M	71,928.00	
(c) Iron, 151,664 pounds, at 8¼ cents	12,891.00	
		100,797.00
8. Steel bridges:		
(a) Steel, 79,600 pounds, at 9 cents	7,164.00	
(b) Lumber, 7,800 feet b. m., at $45 M	351.00	
		7,515.00
9. Excavation in foundations:		
200 cubic yards wet, at $3	600.00	
400 cubic yards dry, at $2	800.00	
		1,400.00
10. Concrete:		
125 cubic yards, class A, at $16	2,000	
425 cublic yards, class B, at $13	5,525	
		7,525.00
11. Timber culverts:		
188,895 linear feet logs, at 25 cents	47,224.00	
19,925 feet b. m., at $45 M	897.00	
76,072 pounds iron, at 8¼ cents	6,466.00	
		54,587.00
12. Riprap, 94 cubic yards, loose rock, at $2		188.00
13. Permanent track, 258,400 linear feet, at $1.89		488,376.00
14. Telegraph line, 48.94 miles, at $250		12,235.00
15. Station buildings, 7, at $2,500		17,500.00
16. Section houses, 3, at $1,500		4,500.00
17. Water stations, 3, at $4,000		12,000.00
18. Passing tracks and station grounds:		
(a) Clearing, 300 feet extra width, 1,000 feet long, 7 by 7 acres, at $100	$4,900.00	
(b) Grading, 7,000 linear feet extra grading, at $2 per foot	14,000.00	
(c) Permanent track, 7,000 linear feet, at $1.89	13,230.00	
(d) Turnouts, 14, at $250	3,500.00	
		35,630.00
19. General expenses		2,450.00
Total		1,674,938.00

Average of 48.94 miles (per mile) = $34,224.

Estimate of cost of Ship Creek branch, Ship Creek to junction with main line (mile 0 to mile 4.89).

Clearing, 200 feet wide, 101 acres, at $75	$7,575.00
Grubbing, 8 acres, at $150	1,200.00
Excavation, earth, 84,970 cubic yards, at 40 cents	33,988.00
Borrow, earth, 31,053 cubic yards, at 40 cents	12,421.20
Overhaul, 283,642 cubic yards, at 1 cent	2,836.42

Timber culverts:		
Logs, 11,722 linear feet, at 20 cents		$2,344.40
Lumber, 5 M b. m., at $40		200.00
Iron, 5,525 pounds, at 8 cents		442.00
Riprap, 26 cubic yards, at $2		52.00
Track (70-pound rail), including surface and ballast, 4.18 miles, at $9,400		39,292.00
Sidetrack and junction, 4,000 feet, at $2		8,000.00
Telegraph line, 4.18 miles, at $250		1,045.00
Buildings at junction, 1 section house and 1 car house		3,000.00
		112,396.02
Add 10 per cent engineering, supervision, and contingencies		11,239.60
Total construction cost		123,635.62

Estimate of cost of Matanuska branch line (mile 0 to mile 38.46).

1. Real estate and right of way		$1,000.00
2. Clearing, 784 acres, at $75		58,800.00
3. Grubbing, 60 acres, at $150		9,000.00
4. Excavations:		
(a) Common excavation, 153,080 cubic yards, at 40 cents	$61,232.00	
(b) Loose rock, 18,920 cubic yards, at 80 cents	15,136.00	
(c) Solid rock, 169,840 cubic yards, at $1.35	229,284.00	
		305,652.00
5. Borrow:		
(a) Common excavation, 503,642 cubic yards, at 40 cents	201,456.00	
(b) Loose rock, 295,000 cubic yards, at 80 cents	236,000.00	
(c) Solid rock, 88,738 cubic yards, at $1.35	119,796.00	
		557,252.00
6. Overhaul, 911,370 cubic yards, at 1 cent per 100 feet		9,114.00
7. Wooden bridges:		
(a) Piling, 17,290 linear feet, at 35 cents	6,052.00	
(b) Lumber, 476,100 feet b. m., at $40 M	19,044.00	
(c) Iron, 183,210 pounds, at 8 cents	14,657.00	
		39,753.00
8. Timber culverts:		
(a) Logs, 26,753 linear feet, at 20 cents	5,351.00	
(b) Iron, 10,529 pounds, at 8 cents	842.00	
		6,193.00
9. Cribs:		
(a) Logs, 68,592 linear feet, at 20 cents	13,718.00	
(b) Piles, 53,018 linear feet, at 35 cents	18,556.00	
(c) Rock filling, 26,850 cubic yards, at $2	53,700.00	
		85,974.00
10. Wing dams:		
(a) Lumber, 364,360 feet b. m., at $40 M	14,574.00	
(b) Iron, 22,089 pounds, at 8 cents	1,767.00	
		16,341.00
11. Riprap, 2,320 cubic yards, at $2		4,640.00
12. Permanent track, 203,059 linear feet, at $1.78½		361,952.00
13. Telegraph line, 38½ miles, at $250		9,625.00
14. Station buildings, 5, at $2,500		12,500.00
15. Section houses, 2, at $1,500		3,000.00
16. Water stations, 2, at $4,000		8,000.00
17. Passing tracks and station grounds:		
(a) Clearing, 300 feet extra width, 1,000 feet long, 5 by 7 acres, at $100	$3,500.00	
(b) Grading, 5 by 3,400 feet, 17,000 linear feet, 3.22 miles, at $10,000	32,200.00	
(c) Permanent track, 17,000 linear feet, at $1.78½	30,303.00	
(d) Turnouts, 10 No. 7 turnouts, complete, at $250	2,500.00	
		68,503.00

18. Miscellaneous structures	$2,000.00
	1,559,299.00
Add 10 per cent for engineering, supervision, and contingencies	155,930.00
Total construction cost	1,715,229.00
Add interest for 1 year, at 3 per cent	51,457.00
Grand total	1,766,686.00
Average per mile, for 38.46 miles (not including interest charges)	40,543.00

ESTIMATE No. 2.—SEWARD TO FAIRBANKS VIA SUSITNA VALLEY AND BRANCH LINES.

RECAPITULATION.

1. Terminal docks and yards at Seward (approximate)	$150,000.00
2. Estimated cost of repairing Alaska Northern R. R. (see Appendix D)	955,601.00
3. New construction, Kern Creek to Fairbanks [1]	22,621,798.00
4. Ship Creek branch [1]	123,635.00
5. Ship Creek terminals (approximate)	25,000.00
6. Matanuska coal branch [1]	1,766,684.00
Grand total [2]	25,642,718.00

Estimates do not include rolling stock.

ESTIMATE No. 3.—SHIP CREEK TO CHICKALOON-MATANUSKA COAL FIELDS.

(74.9 miles.)

RECAPITULATION.

Ship Creek to Chickaloon, 74.9 miles [3]	$3,452,810.00

Estimates do not include rolling stock.

Estimated cost of line Ship Creek-Chickaloon (74.90 miles).

Ship Creek,[4] branch (including 10 per cent)		$123,635.00
Main line,[5] mile 64 to Matanuska Junction	$1,337,766.00	
10 per cent	133,777.00	
		1,471,543.00
Main line station 3508 to station 3600	38,033.00	
10 per cent	3,803.00	
		41,836.00
Matanuska coal branch [4]	1,559,299.00	
10 per cent	155,930.00	
		1,715,229.00
		3,352,243.00
Add 3 per cent interest charge for one-half period construction, one year		100,567.00
Total		3,452,810.00

[1] Details under Estimate No. 1.
[2] Does not include cost of Alaska Northern R. R.
[3] Does not include terminals at Ship Creek, the cost of which would vary according to the extent of its use as a shipping point.
[4] See details Estimate No. 1.
[5] See Details attached.

Estimate of section mile 64.65 to mile 95 (29.81 miles), Ship Creek Summit to Matanuska Junction. (Main line.)

1. Real estate and right of way		$766.00
2. Clearing (200-foot right of way) 669 acres, at $75		50,175.00
3. Grubbing 40 acres, at $150		6,000.00
4. Excavation, prism of cut:		
(a) Common excavation, 394,535 cubic yards, at 40 cents	$157,814.00	
(b) Loose rock, 21,000 cubic yards, at 80 cents	16,800.00	
(c) Solid rock, 218,455 cubic yards, at $1.25	273,069.00	
		447,683.00
5. Borrow:		
(a) Common excavation, 311,490 cubic yards, at 40 cents	124,596.00	
(b) Loose rock, 40,500 cubic yards, at 80 cents	32,400.00	
(c) Solid rock, 73,850 cubic yards, at $1.25	92,313.00	
		249,309.00
6. Overhaul, 1,787,045 cubic yards, at 1 cent per 100 feet		17,870.00
7. Wooden bridges:		
(a) Piling, 73,676 linear feet, at 35 cents	$25,787.00	
(b) Lumber, 1,903,200 feet b. m., $40 M	76,128.00	
(c) Iron, 644,764 pounds, at 8 cents	51,581.00	
		153,496.00
8. Steel bridges:		
(a) Steel, 350,460 pounds, at 8½ cents	29,789.00	
(b) Lumber, 18,200 feet b. m., at $40 M	728.00	
		30,517.00
9. Excavation in foundation, 500 cubic yards wet excavation, at $8		1,500.00
10. Concrete, class B, 780 cubic yards, at $12		9,360.00
11. Timber culverts:		
(a) Logs, 47,271 linear feet, at 20 cents	$9,454.00	
(b) Iron, 17,038 pounds, at 8 cents	1,363.00	
		10,817.00
12. Cribs:		
(a) Logs, 2,600 linear feet, at 20 cents	520.00	
(b) Iron, 680 pounds, at 8 cents	54.00	
		574.00
13. Riprap, 960 cubic yards, at $2		1,920.00
14. Track, 157,405 linear feet, at $1.77		278,607.00
15. Telegraph line, 30 miles, at $250		7,500.00
16. Station buildings, 4 at $2,500		10,000.00
17. Section houses, 1 at $1,500		1,500.00
18. Water stations, 1 at $4,000		4,000.00
19. Passing tracks and station grounds:		
(a) Clearing 300 feet extra width, 1,000 feet long, 4 by 7 acres, at $100	$2,800.00	
(b) Grading, 4 by 3,400 feet=13,600 linear feet=2.58 miles, at $10,000	25,800.00	
(c) Permanent track, 13,600 linear feet, at $1.77	24,072.00	
(d) Turnouts, 8 No. 7 turnouts, complete, at $250	2,000.00	
		54,672.00
20. Miscellaneous structures		1,500.00
Total		1,337,766.00
Average for 29.81 miles, per mile		44,877.00

ESTIMATE No. 4.—CHITINA TO FAIRBANKS.

(313 miles.)

RECAPITULATION.

Chitina to Fairbanks, 313 miles	$13,803,946.00

Estimates do not include rolling stock.

Estimate of constructing line Chitina to Fairbanks (313 miles).

1. Alaskan Engineering Commission's estimate from field surveys, mile 1, Chitina, to mile 50, near Tazlina			$2,118,557.00
Approximate estimate, mile 50, near Tazlina, to mile 313, at Fairbanks (computed from Deyo's 1910 surveys):			
1. Real estate and right of way			20,000.00
2. Clearing, 263 miles, 6,376 acres, at $75			478,200.00
3. Grubbing, 5 acres to mile, 263=1,315 acres, at $150			197,250.00
4. Excavation:			
(a) Common, 3,517,943 cubic yards, at 75 cents	$2,638,457.00		
(b) Loose rock, 78,600 cubic yards, at 85 cents	66,810.00		
(c) Solid rock, 214,926 cubic yards, at $1.50	322,389.00		
			3,027,656.00
5. Borrow, common, 65,062 cubic yards, at 75 cents			48,797.00
6. Culverts, 263 miles, at $500			131,500.00
7. Pile and frame trestles			910,500.00
8. Bridges, steel and masonry			897,000.00
9. Tunnels, 700 linear feet, at $85			59,500.00
10. Permanent track, 263 miles, at $9,768 per mile			2,568,984.00
11. Passing tracks and station grounds:			
(a) Clearing 300 feet extra width 1,000 feet long=7 acres; 38 by 7 acres=266 acres, at $75	$19,950.00		
(b) Grading, 38,000 linear feet, at $2	76,000.00		
(c) Track, 38,000 linear feet, at $1.85	70,300.00		
(d) Turnouts, 76, at $250	19,000.00		
			185,250.00
12. Station buildings, 38, at $2,500			95,000.00
13. Section houses, 12, at $1,500			18,000.00
14. Water stations, 12, at $4,000			48,000.00
15. Telegraph line, 263 miles, at $250			65,750.00
16. Miscellaneous structures			13,150.00
17. Snow fences, 78,309 linear feet, at 34 cents			26,625.00
18. Snowsheds, 14,080 linear feet, at $50			704,000.00
19. Three divisional terminal yards			225,000.00
			11,838,719.00
Add 10 per cent for engineering, superintendence, and contingencies			1,183,872.00
Total construction cost			13,022,591.00
Add interest charges at 3 per cent for half period of construction (2 years)			781,355.00
			13,803,946.00

ESTIMATE No. 5.—COAL BRANCH TO LAKE CHARLOTTE.

(25.36 miles.)

RECAPITULATION.

Mile 39, Copper River & Northwestern Railroad to Lake Charlotte, 25.36 miles	$1,023,440.00

Estimates do not include rolling stock.

Estimate Lake Charlotte to Katalla Junction, Bering coal fields of Copper River & Northwestern Railway (mile 0 to 25.36), 25.36 miles.

1. Real estate and right of way		$1,000.00
2. Clearing, 347 acres, at $75		26,025.00
3. Brubbing, 22 acres, at 150		3,300.00
4. Excavation:		
(*a*) Common, 30,475 cubic yards, at 40 cents	$12,190.00	
(*b*) Loose rock, 16,230 cubic yards, at 80 cents	12,984.00	
(*c*) Solid rock, 185,885 cubic yards, at $1.25	232,356.00	
		257,530.00
5. Borrow, common, 476,499 cubic yards, at 40 cents		190,600.00
6. Wooden bridges:		
(*a*) Piles, 72,910 linear feet, at 35 cents	$25,519.00	
(*b*) Lumber, 1,321,430 feet b. m., at $40 M	52,857.00	
(*c*) Iron, 149,190 pounds, at 8 cents	11,935.00	
		90,311.00
7. Timber culverts and track boxes:		
(*a*) Logs, 76,815 linear feet, at 20 cents	15,363.00	
(*b*) Lumber, 7,588 feet b. m., at $40 M	304.00	
(*c*) Iron, 28,427 pounds, at 8 cents	2,274.00	
		17,941.00
8. Riprap (loose), 1,364 cubic yards, at $2		2,728.00
9. Track, permanent, 133,820 linear feet, at $1.78		238,200.00
10. Telegraph line, 25.36 miles, at $250		6,340.00
11. Station buildings, 3, at $2,500		7,500.00
12. Section house, 1, at $1,500		1,500.00
13. Water station, 1, at $4,000		4,000.00
14. Passing tracks and station grounds (4, at 3,400 feet):		
(*a*) Clearing 300 feet extra width 1,000 feet long=7 acres, 4 by 7 acres, at $100	$2,800.00	
(*b*) Grading, 4 by 3,400 feet, 13,600 linear feet, 2.58 miles, at $10,000	25,800.00	
(*c*) Permanent track, 13,600 linear feet, at $1.78	24,208.00	
(*d*) Turnouts, 9 No. 7 switches, at $250	2,250.00	
		55,058.00
15. Miscellaneous structures		1,268.00
Total		903,301.00
Add 10 per cent for engineering, supervision, and contingencies		90,330.00
		993,631.00
Add interest charges at 3 per cent for half period of construction (2 years)		29,809.00
Grand total		1,023,440.00
Average for 25.36 miles (per mile)		35,619.00

ESTIMATE No. 6.—CHITINA TO MATANUSKA COAL FIELDS.

RECAPITULATION.

1. Chitina to Copper Center, 50 miles	$2,400,325.00
2. Copper Center to Chickaloon, 113 miles	4,520,061.00
	6,920,386.00

Estimates do not include rolling stock.

Estimate of Chitna–Matanuska line (mile 0 to mile 162.08) 162.08 miles.

1. Real estate and right of way		$2,000.00
2. Clearing, 1,756 acres, at $100		175,600.00
3. Grubbing, 22,791 square rods, at $1		22,791.00
4. Excavation:		
(a) Common, 2,796,738 cubic yards, at 56 cents	$1,566,173.00	
(b) Solid rock, 601,835 cubic yards, at $1.50	902,752.00	
		2,468,925.00
5. Borrow, 106,189 cubic yards, at 40 cents		42,476.00
6. Overhaul, 3,782,498 cubic yards, at 1 cent		37,825.00
7. Tunnels, 1,170 linear feet, at $70		81,900.00
8. Piling, 222,666 linear feet, at 35 cents		77,933.00
9. Lumber, 5,676,105 feet b. m., at $50 per M		283,805.00
10. Logs for culberts, 47,890 linear feet, at 25 cents		11,972.00
11. Iron, 567,706 pounds, at 10 cents		56,771.00
12. Steel, 8,955,020 pounds, at 10 cents		895,502.00
13. Concrete, 15,368 cubic yards, at $15		230,520.00
14. Tracks with ballast, telegraph line, station buildings, and water tanks		1,720,000.00
Total		6,108,020.00
Add 10 per cent for engineering, supervision, and contingencies		610,802.00
		6,718,822.00
Add interest charges of 3 per cent for half period of construction (2 years)		201,564.00
Grand total		6,920,386.00
Average for 162.08 miles (per mile) =		37,685.00

ESTIMATE No. 7.—LINE NORTH BANK OF TANANA RIVER.

Chena to Nenana, 50.49 miles $2,457,441.00

Estimates do not include rolling stock.

Estimate of section, Nenana to Fairbanks, north bank of Tanana River (mile 362.22 to mile 412.71), 50.49 miles.

1. Real estate and right of way		$10,000.00
2. Clearing, 867 acres, at $75		65,025.00
3. Grubbing, 82 acres, at $150		12,300.00
4. Excavation:		
(a) Common, 248,645 cubic yards, at 75 cents	$186,484.00	
(b) Loose rock, 35,780 cubic yards, at 85 cents	30,413.00	
(c) Solid rock, 614,110 cubic yards, at $1.50	921,165.00	
		1,138,062.00

5. Borrow, common, 234,670 cubic yards, at 50 cents		$117,335.00
6. Overhaul, 5,223,000 cubic yards, at 1 cent 100 feet		52,230.00
7. Wooden bridges:		
(a) Piling, 43,961 linear feet, at 40 cents	$17,584.00	
(b) Lumber, 897,200 feet b. m., at $45 M	40,374.00	
(c) Iron, 138,844 pounds, at 8½ cents	11,802.00	
		69,760.00
8. Excavation in foundations, 725 cubic yards, at $2		1,450.00
9. Timber culverts:		
(a) Logs, 36,290 linear feet, at 25 cents	$9,073.00	
(b) Piles, 5,700 linear feet, at 40 cents	2,280.00	
(c) Lumber, 81,600 feet b. m., at $45 M	3,672.00	
(d) Iron, 22,953 pounds, at 8½ cents	1,951.00	
		16,976.00
10. Cribs:		
(a) Logs, 200,600 linear feet, at 25 cents	$50,150.00	
(b) Iron, 118,900 pounds at 8½ cents	10,107.00	
		60,257.00
11. Riprap, 368 cubic yards loose rock, at $2		736.00
12. Permanent, 266,630 linear feet, at $1.88		501,264.00
13. Telegraph lines, 50.5 miles, at $250		12,625.00
14. Station buildings, 7, at $2,500		17,500.00
15. Section houses, 2, at $1,500		3,000.00
16. Water stations, 2, at $4,000		8,000.00
17. Passing tracks and station grounds:		
(a) Clearing, 300-foot width, 17,000 feet long=117 acres, at $100	$11,700.00	
(b) Grading, 17,000-foot track=3.22 miles, at $10,000	32,200.00	
(c) Permanent track, 17,000 linear feet, at $1.88	31,960.00	
(d) Turnouts, 16, No. 7 complete, at $250	4,000.00	
		79,860.00
18. Miscellaneous		2,500.00
		2,168,880.00
Add 10 per cent for engineering, superintendence, and contingencies		216,888.00
Total construction cost		2,385,768.00
Add interest charges at 3 per cent for half period of construction (1 year)		71,673.00
Total		2,457,441.00
Average for 50.5 miles (per mile)=		52,948.00

ANNUAL REPORT

OF THE

CHAIRMAN OF THE ALASKAN ENGINEERING COMMISSION

TO THE

SECRETARY OF THE INTERIOR

FROM FEBRUARY 1 TO DECEMBER 31, 1915.

LETTERS OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
Washington, January 7, 1916.

MY DEAR MR. PRESIDENT: There is transmitted herewith the report of the Alaskan Engineering Commission for the period from February 1 to December 31, 1915.

Cordially, yours,

FRANKLIN K. LANE.

The PRESIDENT, *The White House.*

DEPARTMENT OF THE INTERIOR,
ALASKAN ENGINEERING COMMISSION,
Washington, D. C., December 31, 1915.

SIR: I have the honor to transmit the accompanying report of the work accomplished under the direction of the Alaskan Engineering Commission during the season of 1915.

On February 11, 1915, the commission submitted to the President the report of the investigations made of the various proposed railroad routes in Alaska during the season of 1914, together with maps, profiles, and estimates of costs along these various routes. From these the President was to decide as to the route most feasible to adopt, and the one that would best develop the resources of Alaska, in compliance with the authority contained in the Alaskan railroad act (38 Stat., 305).

Respectfully,

WM. C. EDES, *Chairman.*

The SECRETARY OF THE INTERIOR.

26484°—H. Doc. 610, 64-1, pt 2——12

REPORT OF ALASKAN ENGINEERING COMMISSION, 1915.

ORDERS TO COMMISSION.

On April 10, 1915, the President issued the following Executive order outlining the selected route:

EXECUTIVE ORDER.

By authority of an act entitled "An act to authorize the President of the United States to locate, construct, and operate railroads in the Territory of Alaska, and for other purposes" (38 Stat., 305), I do now designate and cause to be located the following routes for lines of railroad in the Territory of Alaska:

For a main line of railroad:

Commencing at the town of Seward, on the westerly shore of Resurrection Bay, Alaska; thence following along said westerly shore in a northerly direction to the head of said bay; thence following up the drainage of Salmon Creek to a summit between said drainage and the drainage of Snow River; thence following the drainage of Snow River to Kenai Lake; thence continuing northerly along the easterly shore of Kenai Lake, along Falls Creek, along the shores of Lower and Upper Trail Lake, and up Trail Creek to a summit in the Kenai Mountains near mile 45 from Seward; thence descending along the drainage of Placer River to the head of Turnagain Arm of Cook Inlet; thence following the northeasterly shore of said Turnagain Arm and crossing Portage Creek and Twenty-Mile River to the mouth of Kern Creek near mile 71 from Seward; thence in a northwesterly direction along the shore of Turnagain Arm to near the mouth of Big Rabbit Creek; thence leaving Turnagain Arm and running northerly to a summit in section 26, township 14, north range 3 west, Seward meridian; thence running northeasterly to near the head of Knik Arm of Cook Inlet; thence running northerly across the flats at the head of said arm and crossing Knik and Matanuska Rivers to a point about 2 miles north of the Matanuska River; thence running in a westerly and northwesterly direction, crossing the Little Susitna River and following along the southwesterly slopes of Bald Mountain to Willow Creek, a tributary of the Susitna River; thence in a northerly direction following the drainage of the Susitna and Chulitna Rivers to Broad Pass, situated in the main Alaska Range of mountains; thence crossing Broad Pass and entering the drainage of the Nenana River; thence continuing northward following the drainage of the Nenana River to the Tanana River, the total distance from Seward being 416 miles, more or less.

Also starting from a point on the above-described line, situated 2 miles, more or less, northerly from where said line crosses the Matanuska River, and thence running in an easterly direction following the drainage of said Matanuska River and its tributaries, a distance of 38 miles, more or less, to the Matanuska coal fields.

And in order to complete the construction of the lines so designated and located, I direct the Secretary of the Interior to purchase and acquire the line of railroad known as the Alaska Northern Railway, and for that purpose to execute and enter into an agreement substantially in the form hereto annexed, which calls for the payment of a purchase price not in excess of the physical value of said railway.

Effective this date, April 10, 1915.

WOODROW WILSON.

THE WHITE HOUSE.

The following letters were addressed by the President to the Secretary of the Interior on April 10 and April 30, 1915, respectively:

To the SECRETARY OF THE INTERIOR:

Pursuant to the provisions of the act of March 12, 1914, providing for the construction of railroads in the Territory of Alaska, I direct you to proceed with the construction of the routes now located, and I confer upon you the power and authority to do any and all acts necessary thereto.

This work will, under your supervision, be carried on by the Alaskan Engineering Commission.

The commission is henceforth charged with the general duty of preparing and adopting plans for construction, with the employment of such force as may be from time to time necessary, and with the making of all contracts for the purchase of the necessary supplies and plant for this work.

For the proper prosecution of the work you will designate one of the members of the commission its chairman, who shall be in immediate charge of the work in Alaska and have power of approval or disapproval of all administrative matters connected with the work in Alaska. He shall organize the work into such departments as seem advisable. Each department shall perform such duties as may from time to time be assigned to it by the chairman. Among such departments shall be a department of construction and engineering, which may be subdivided into divisions in the discretion of the chairman, who will also be the chief engineer. The heads of the several departments shall be appointed by and report to the chairman, and their salaries, except where such heads of departments are members of the commission, shall be fixed by him, subject to the disapproval of the commission as a whole. Officers and employees in the several departments shall be appointed and their salaries primarily fixed by the head of the department by which they are engaged, after consultation with the chairman and subject to the disapproval of the commission.

Contracts for the purchase of supplies shall be made only after public advertisement in one or more newspapers of general circulation in the district where such supplies may, in the judgment of the chairman, best be purchased, and shall be awarded to the lowest responsible bidder, excepting in cases of emergency, when, with the consent or approval of the Secretary of the Interior, advertising may be dispensed with.

In making contracts for construction work, so far as may be, competitive bids shall be secured by invitation or advertisement when practicable. So far as the work may be carried on by the letting of contracts to station men, competitive bids shall be secured by invitation on the ground where the work is to be carried on, but in such manner that the work of construction as a whole may be expedited.

The head of each department shall make a report of the work and operation of his department to the chairman of the commission as often as may be required. The Secretary of the Interior shall make to the President a report, at least annually, and as often as he may deem advisable or the President may require.

The chairman of the commission shall make a report to the Secretary of the Interior, setting forth the results accomplished by each department of the work, as often as he may deem advisable or the Secretary may require.

The members of the commission shall proceed to the Territory of Alaska and remain there at least until October 1, except when on leave of absence, which will be granted to the members of the commission by the chairman, and to the chairman by the Secretary of the Interior. In case of absence from the Territory, the chairman will designate a member of the commission to act in his stead.

If there shall be any machinery, equipment, instruments, material or other property of any sort required in connection with the construction of the Isthmian Canal which is desired by the Alaskan Engineering Commission for use in the construction of the routes designated in Alaska, the Alaskan Engineering Commission will, by its chairman or any members, request the same from the governor of the Isthmian Canal, and he will, so far as and as rapidly as the same is no longer needed at Panama, deliver said property to such officers or persons as the Alaskan Engineering Commission by its chairman or a member may designate.

Under the contract which I have authorized for the purchase of the Alaska Northern Railway you will, on being advised by counsel to the commission

as to the title to be acquired, give the notices therein required, make the initial payment, and take over control of the railway and, so far as may be advisable, use the same in the construction work. So far as it may become necessary to spend moneys upon the Alaska Northern Railway for construction, you will advance such moneys to the railway from the funds appropriated under the act of March 12, 1914. The immediate conduct of the affairs of the railway will be in the hands of the commission, and the chairman of the commission may become president of the railway.

The commission will cooperate with the duly constituted authorities of Alaska in the preservation of law and order during the work of construction.

I charge the commission particularly with the preparation and maintenance of such arrangements as may be required for the health of the men engaged in the work of construction and I instruct you to prepare and adopt a proper system of compensation for accidents which may occur on the work, in general on the lines of the system now in force in the construction of the Isthmian Canal, but such system shall be so framed that its benefits will be applicable not only to those who are directly in the service of the commission upon salary, but also to those who may, by contract with the commission, be actually engaged in the work of construction in Alaska.

Effective this date, April 10, 1915.

WOODROW WILSON.

THE WHITE HOUSE.

To the SECRETARY OF THE INTERIOR:

By virtue of the authority vested in me by the act of Congress approved March 12, 1914, entitled "An act to authorize the President of the United States to locate, construct, and operate railroads in the Territory of Alaska, and for other purposes," I hereby direct that all work of the Alaskan Engineering Commission under all orders made by me and the carrying out of all contracts entered into by my direction under authority of said act, be performed under the supervision and control of the Department of the Interior, as directed by the head thereof, in all respects and to all intents and purposes the same as if said work had been placed by law under the jurisdiction and control of the Department of the Interior.

I also direct that contracts for the purchase of supplies by the Alaskan Engineering Commission shall be made after advertisement in such manner as shall best serve the interests of the Government, in the district of Alaska, or otherwise, where such supplies may, in the judgment of the chairman of the commission, best be purchased and shall be awarded to the lowest responsible bidder.

Except so far as they are inconsistent with and changed by this order, I direct that the Executive orders of April 10, 1915, continue in force.

WOODROW WILSON.

THE WHITE HOUSE, *April 30, 1915.*

The Secretary of the Interior furnished the members of the commission copies of the foregoing Executive order and letters from the President, and issued instructions for them to proceed to the field to complete the necessary surveys and commence construction.

The following order was issued by the Secretary of the Interior on April 16, 1915:

ORDER A. E. C. 1.

The chairman of the Alaskan Engineering Commission will submit to me at the end of each month, beginning with the current month, a statement showing in detail, in parallel columns, properly classified, the character of all expenditures made by each special disbursing agent of the commission.

FRANKLIN K. LANE,
Secretary.

ORGANIZATION AND PLAN OF OPERATIONS, 1915.

Somewhat forestalling the public announcement of the route selected the commission had on February 27, submitted to the Secretary of the Interior for his consideration plans, organization,

schedule of operations, and estimate of proposed expenditures for continuing the work of the commission during the remainder of the fiscal year 1915 and for the fiscal year 1916 as outlined in the following letter:

ALASKAN ENGINEERING COMMISSION,
Washington, D. C., February 27, 1915.

The SECRETARY OF THE INTERIOR.
Washington, D. C.

SIR: Pursuant to your request, I have the honor to submit plans, organization, and schedule of operations for continuing the work of this commission during the fiscal year ending June 30, 1916.

SCOPE OF WORK.

It is recommended that our activities be confined to the following projects:

(*a*) The operation and maintenance of the Alaska Northern Railroad, including the steamship wharf.
(*b*) The reconstruction of the Alaska Northern Railroad from mile 1, at Seward, to mile 71, at Kern Creek.
(*c*) The construction of necessary terminals, freight yard, roundhouse, shops, etc., at Seward.
(*d*) The construction of a temporary telephone and telegraph line, Kern Creek to Anchorage.
(*e*) The construction of temporary loading and unloading facilities at Anchorage.
(*f*) The construction of Ship Creek Branch to connect with the main line.
(*g*) The construction of 30 miles of main line, mile 63 to mile 93, Ship Creek Junction to Matanuska River.
(*h*) The conduct of the four locating parties making field surveys between Kern Creek and Fairbanks.

The appropriations available and the proposed allotment of funds are given in the following statement:

Appropriations available, period February 1, 1915, to June 30, 1916.

1. Balance, 1915 appropriation available Feb. 1, 1915	$607,095
2. Appropriation, 1916	2,000.000
Total	2,607,095

Proposed expenditures, period Mar. 1, 1915, to June 30, 1916.

1. Expenses of the commission, Feb. 1 to June 30, 1915	$65,052
2. Headquarters office and other administrative expenses, Seward, July 1, 1915, to June 30, 1916	[1] 75,000
3. Amount to be paid on Alaska Northern R. R	500,000
4. Amount necessary to expend to rejuvenate the Alaska Northern R. R., for year 1916	250,000
5. Location surveys, south end, two parties, six months	60,000
6. Location surveys, north end, two parties, four months	60,000
7. Telephone line, mile 18, Kern Creek to Anchorage	5,000
8. Temporary dock, Anchorage	12,000
9. Dredging at Anchorage	40,000
10. Shipment of dredge and other construction material, Panama to Anchorage	75,000
11. Terminal yard, Anchorage	5,000
12. Machine shop and engine house, Anchorage	20,000
13. Overhauling launches, Anchorage	2,500
14. Ship Creek Branch	125,000
15. Main line, Ship Creek Junction to Matanuska River	1,302,643
16. Purchasing department, Seattle	9,900
Total	2,607,095

[1] This item would be reduced by revenue derived from operation of Alaska Northern Railroad and Steamship Wharf.

HEADQUARTERS OF COMMISSION.

In order to carry out the work as above outlined, it is recommended that the headquarters of the commission be established at Seward, and that the chairman of the commission take station there and from that point direct, supervise, and control all work in Alaska.

Seward has many advantages as headquarters. It is located on a port, open the year round, giving access to the outside world. It is in close touch with the important work of rebuilding the Alaska Northern Railroad. Anchorage can be reached by one day's journey by water in the summer season, and when the line along Turnagain Arm is completed it will be in touch by rail at all times with other parts of the line.

LOCATION SURVEYS.

It is recommended that four locating parties be put into the field during the open season, two of these to work at the southern end in the Knik Arm-Susitna Valley district under the jurisdiction of a member of the commission at Anchorage and the other two to work in the northern section, near Fairbanks and along the Nenana River, under the jurisdiction of a member of the commission stationed at Fairbanks. The work of these parties will make available sufficient definite location to enable the construction work to continue as fast as desired in the fiscal year ending June 30, 1917.

CONSTRUCTION MAIN LINE, ANCHORAGE TO MATANUSKA RIVER.

It is proposed to make Anchorage the base of operations for attacking the line, Ship Creek to the Matanuska coal fields, said work to be in charge of a member of the commission stationed at that point. The scheme contemplates constructing certain necessary unloading facilities of a temporary character at Anchorage, and the building of the Ship Creek branch line, 5 miles, and about 30 miles of main line, Ship Creek Junction to Matanuska Junction. It is proposed to operate a ladder dredge in the summer season to secure an approach channel to landing wharf. A material yard, engine house, construction machine shop, etc., would also be built.

Very respectfully,

WM. C. EDES, *Chairman.*
F. MEARS, *Member.*
THOMAS RIGGS, Jr., *Member.*

As shown on a preceding page, the funds available for the work at the beginning of the season of 1915 were a balance of $607,095 remaining from the original appropriation of $1,000,000, and an additional appropriation of $2,000,000 contained in the sundry civil approprition bill, approved March 3, 1914, which became available on July 1, 1915.

The general deficiency appropriation bill (38 Stat., 1138) approved March 4, 1915, contained the following provision:

In the execution of the work called for under the act of March twelfth, nineteen hundred and fourteen (Thirty-eighth Statutes, page three hundred and five), entitled "An act to authorize the President of the United States to locate, construct, and operate railroads in the Territory of Alaska, and for other purposes," authority is hereby granted to purchase, until the end of the fiscal year nineteen hundred and sixteen from the appropriations made therefor, articles and supplies for sale to employees, the appropriation to be reimbursed by the proceeds of such sales.

The Executive order of April 10, 1915, having extended the duties of the commission to include the construction of the railroad, immediately after the announcement of the route, steps were taken to start active operations.

The Secretary of the Interior, after conference with the commission, approved the plan of operations for the continuance of surveys

and commencement of construction for the Alaskan railway project, as previously outlined herein.

William C. Edes, as chairman of the commission, was designated as chief engineer and placed in general supervision of all of the commission's activities, with headquarters at Seward, at which point it was decided to locate the administrative offices of the railway work. The chairman was to have active charge of the Alaska Northern Railway when taken over by the Government.

Frederick Mears, member of the commission, was placed in charge of the work of construction of new line. The construction was to begin at the point where Ship Creek enters Knik Arm of Cook Inlet. This point, known originally as Ship Creek, but more recently as Anchorage, is 120 miles north from Seward and 5 miles west of the line of the main trunk route from Seward to Fairbanks, and is the head of navigation for ocean-going steamers. The building of the comparatively inexpensive 5-mile spur enabled the establishment of an excellent construction base. Deep-draft vessels can anchor off this point, thus facilitating the landing of construction supplies. Using this as a distributing point, the railroad line can be quite easily reached at various places by light-draft boats and scows carrying supplies and construction material, as the survey follows, within a short distance, the shore of Knik Arm for a distance of 30 miles. The commission's headquarters camp had been established at this place during the surveying season of 1914. The line along which construction was to proceed extends in a general northerly direction toward the interior valleys and the Matanuska coal fields and had been definitely located for a considerable distance the previous year.

Anchorage will furnish an available shipping point for the products of the Matanuska coal fields during a considerable portion of each year.

While the surveys and investigations made in 1914 were sufficient to determine the most feasible general route, the major portion of the line had to be gone over in detail and a final location marked out on the ground. It was decided to fit out three locating parties at Anchorage to locate the line north to Broad Pass and the branch line leading to the Matanuska coal fields, and to send two parties, in charge of Commissioner Riggs, to make the final location north from Broad Pass to Fairbanks. This portion of the line, especially certain stretches along the Nenana River, required considerable additional investigation to determine the most feasible and economical route. After leaving the Nenana River there are three possible routes to Fairbanks, not varying very much in cost. It was determined to use the route along Goldstream Creek and put the final location on that line.

Anticipating the need of considerable quantities of supplies and equipment, especially for the work of construction, the commission established a purchasing office at Seattle, Wash., in charge of C. E. Dole as purchasing agent. Mr. Dole was formerly chief clerk to the general purchasing officer of the Panama Canal at Washington, D. C.

The Alaskan Railroad act (38 Stat., 305) provides for the free transfer of equipment and material purchased for use in the construction of the Panama Canal, for utilization in the construction of the Government railway system in Alaska when no longer needed in the Canal Zone.

The commission sent a representative to the Isthmus in March, 1915, to arrange for the assembling and shipment to Alaska of available machinery and material which will be of service in the railway construction.

STARTING CONSTRUCTION FROM ANCHORAGE NORTH.

Somewhat anticipating the formal announcement of the selected route, a member of the commission had been in Seattle for some weeks preparing proposals for supplies to be shipped to whichever point in Alaska should be selected as the construction base. Arrangements were made for the purchase and shipment of equipment, material, and supplies necessary for starting the work of construction and the outfitting of the location parties who were to operate south of Broad Pass. About $40,000 were expended for these purposes. Included in this first shipment were pile-driver outfit, hoisting engine, light rail, lumber, and the various tools and appliances necessary for the construction of a temporary wharf at Anchorage. In addition to engineering and office forces a limited number of pile-driver operators, carpenters, and other skilled laborers were employed, so that their services might be immediately available upon arrival in Alaska. The party left Seattle on April 18 in charge of Commissioner Mears, and arrived at Anchorage on April 26.

The character of the harbor at anchorage is such that until a channel can be dredged no wharf can be constructed at which deep-draft steamers can dock. It is therefore necessary to transfer all material to barges, which are taken to the shore at proper stages of the tide. A very serviceable dock was constructed on the north bank of Ship Creek near the mouth. In front of the dock was constructed a "gridiron," over which the barges were floated at high tide and on which they safely rested at low tide, thus avoiding any difficulty in unloading. A 15-ton derrick, operated by hoisting engine, was equipped for unloading the barges. Before leaving Seattle a 1,000-ton barge and three lighters had been purchased, these to be delivered at Anchorage, also material for the construction of a 200-ton barge was shipped and the barge was put together at Anchorage.

This marine equipment constituted a floating dock, enabling a ship to discharge its cargo, and also a fleet of lighters for transferring the cargo to the shore. This equipment has been largely augmented by additions from time to time as the movement of supplies increased. The commission had at Anchorage several towboats that had been in the engineering service the previous year, and there were also available for towing purposes various gasoline boats belonging to private parties. It is necessary that cargoes be discharged promptly to avoid a heavy demurrage by ocean steamers.

The first shipload of supplies and material was quickly unloaded, and steps were taken to enlarge the terminal facilities. A large warehouse was constructed at the dock for the storage of commissary supplies, and a track was laid from the dock to a storage yard, a half mile distant, to which point lumber and construction material were taken. Some flat cars were taken from the stock of the Alaska Northern Railroad at Seward and brought by steamer to Anchorage for the handling of construction material.

BEGINNING OF CONSTRUCTION WORK.

As soon as it became known that Anchorage was to be the starting point of the construction work many persons seeking employment gathered there, and it was but a few weeks before Anchorage became a town of 2,000 people, living in tents and log houses. It was necessary to start some work as soon as possible in order to find employment for at least a portion of this population. A number were employed in handling the supplies and construction equipment that arrived on each incoming steamer. These men were hired as day laborers and received a wage of 37½ cents per hour, eight hours constituting a day's work. For certain classes of skilled labor, such as carpenters, blacksmiths, etc., higher rates were paid. In fixing the wage schedule for common labor the hourly rate used did not have as much weight with the individual workers as the total amount earned for the day, as most men in Alaska had been accustomed to work 10 hours per day. It is probable there would have been little difficulty in getting men for a considerable less rate per hour if they had worked on a 10-hour schedule, thereby earning more per day. It was therefore decided to pay the rate of 37½ cents per hour, enabling the men to make $3 in the 8 hours. The work was pretty hard, and probably good men could not have been secured for a less wage. Many of the men working about the material yard were subsisted at the mess house, where excellent meals were furnished at $1 per day. A number of men were also employed in building wagon roads and at various other tasks. In these various occupations there were employed at the end of May about 100 men. During much of the following summer this number was increased to about 600.

STATION MEN.

It had been decided that the best method to pursue in the actual construction of the railroad where the work could be classified and contracted for at unit prices was by the use of "station men." Under this method a number of men associate themselves together as partners, taking short pieces of work at a certain price per cubic yard for grading, or per acre for clearing or grubbing. Each man signs the contract for doing the work and becomes equally interested in it as a copartner or small contractor. Each man receives his separate check for doing his portion of the work. The amount received depending upon the amount of work done, the men are spurred to exert their best efforts. Scarcely any capital is necessary to take a station contract, as the commission furnishes the necessary equipment at a moderate rental. The men also have the privilege of purchasing supplies at reasonable prices at the commissary established by the commission. This is not obligatory, however, as they can purchase elsewhere if they so desire. This method is largely used in railroad construction through the West, and good results are obtained. When work is let in large contracts much of it is eventually "stationed" out. In the case of the Government railroad the large contractor was eliminated, and the station men consequently received more for their work. The profits made by the station men have varied, according to the skill and experience of the men. The average gross wages received by 46 station gangs on grading were 41 cents per hour per man. The gross wages received by 31 station

gangs on clearing work were 60 cents per hour per man. Gross wages are wages earned after making all deductions for cost of tools, explosives, team hire, outfit rentals, and hired labor, but not subsistence. The number of men on station work fluctuated from about 400 early in June to 724 in the latter part of July. The number then gradually decreased until the latter part of November, when the grading planned for the season was practically completed.

GENERAL CONDUCT OF THE WORK.

The work which was contemplated to be accomplished with the appropriation available from February 1, 1915, to June 30, 1916, was to build from Anchorage, on Knik Arm of Cook Inlet, to the Matanuska River, a distance of 35 miles, besides establishing certain terminal and marine facilities at Anchorage. The first work began in May, 1915, when clearing of the right of way commenced, and the grading forces were placed on the work as rapidly as the engineers could mark it out and station contracts could be made. Supply camps were established at various points along the line, these camps, as far as possible, being supplied by barges working on Knik Arm. In addition quite an outfit of freight teams were also used.

All material removed in the grading was classified under one of the three following heads: Solid rock, loose rock, and common excavation. (For full specifications covering these classifications see Appendix B.) The prices paid were: For solid rock excavation, 75 cents per cubic yard; for loose rock excavation, 32 to 35 cents per cubic yard; and for common excavation, 25 cents per cubic yard. In a few instances slight deviations were made from these prices because of exceptional conditions. Where material had to be hauled a distance in excess of 400 feet an additional price of 1 cent per cubic yard per 100 feet was paid.

For clearing right of way the price ranged from $30 to $75 per acre, depending upon the character and density of the timber. For piling and culvert timbers a price of from 10 to 15 cents per linear foot was paid. The native timber was cut into ties, these costing the commission from 35 to 37 cents each, delivered at Anchorage or along the line of the road. (Copies of contracts for performing station work and for cutting ties, piling, etc., will be found in Appendixes C to E.)

Lumber for the construction of bridges and buildings was imported from Puget Sound, it not being feasible to obtain same locally. The prices paid varied from $15 to $28 per thousand feet, board measure, according to quality, delivered at Anchorage. An average of $18.20 per thousand feet, board measure, was paid for a quantity of lumber containing over 2,000,000 feet. There are several large bridges in the course of erection between Anchorage and the Matanuska River. It was found to be more economical to erect these bridges, as they could be reached by the railroad track rather than to haul in the material by teams. The piling used in the foundations being obtained in the vicinity of the bridges could be driven before the track could be constructed to the bridge sites. The bridge timbers were framed in the material yard at Anchorage and hauled by construction train to the sites.

CONSTRUCTION COMPLETED DECEMBER 31, 1915, FROM ANCHORAGE, NORTH.

Clearing of right of way began at Anchorage in May and grading began soon thereafter. Gangs of station men were placed on the work as fast as satisfactory arrangements could be made with them. At the time of writing (Dec. 31, 1915) the following results have been accomplished: Right of way cleared for 40 miles, 712 acres; right of way grubbed for 40 miles, 114 acres; grading completed for 35 miles; material excavated and borrowed, 923,480 cubic yards. Track has been laid to Eagle River, a distance of 13¼ miles. At this point the first large bridge is encountered. This bridge has been practically completed, and within the first few days of the new year (1916) track will be laid across the bridge. Track laying will then immediately proceed northward at the rate of about half a mile per day, the other bridges being erected when they are reached with the track.

DREDGING AT ANCHORAGE.

In the original estimate submitted by the commission it was contemplated that considerable dredging should be done in Ship Creek. Not being able to obtain a dredge at Panama, this work was postponed for the season. Borings have been made to determine the character of the material and tentative plans have been considered for the development of the harbor. As soon as funds are available steps will be taken to secure equipment with which to do the work. An interior basin can be dredged and coal-shipping facilities developed at a reasonable cost. Work on these improvements will be prosecuted vigorously during the coming season.

ANCHORAGE FREIGHT YARD.

About three miles of yard tracks have been laid and provision made for such additional tracks as may from time to time be required. A carpenter shop, lumber shed, machine shop, and small engine house have been erected. Also, a water tank and pumping plant. Proper sewerage arrangements have been provided.

TELEPHONE LINE, SEWARD TO ANCHORAGE.

A temporary telephone line has been erected from Seward to Anchorage, a distance of 120 miles, thereby greatly facilitating the interchange of communications by the commission between those points. The line has been equipped for operation either for telephone or telegraph. Commercial business is also accepted for transmission over this line and in this manner some revenue is received. It is expected that the line will soon be self-supporting.

MARITIME EQUIPMENT.

Soon after operations began at Anchorage the commission found that their maritime equipment would have to be largely increased. Not only is it necessary for the commission to have an extensive lighterage equipment for its own freight, but the various merchants

and others brought in large amounts of supplies which it was necessary to transport quickly from ship to shore. The facilities provided by local parties for handling this commercial lighterage were entirely inadequate, and the commission had to provide for handling practically all of it. Purchases of additional towboats and barges were made and there is now invested in this equipment approximately $75,000.

A considerable revenue is derived from handling this commercial freight. A marine railway has been constructed for landing and storing the floating equipment during the winter.

COMMISSARY.

Under the authority given in the act approved March 4, 1915 (38 Stat., 1138), the commission established a commissary at Anchorage, from which all employees can purchase supplies at reasonable rates. This is self-supporting. Supplies for station men are furnished them and charged against their work. Employees are not restricted to the commissary in making purchases of supplies, but are free to purchase elsewhere if they so desire. The same provision applies to the station men.

HOUSES FOR PERMANENT EMPLOYEES.

During the season 15 cottages have been erected for the use of permanent employees having families. The total cost of these cottages was $25,655. A rental of 12 per cent per year on the cost is charged.

AMUSEMENT HALL.

Realizing the importance of some innocent forms of recreation for its employees during their leisure hours, the commission has provided a small hall where may be found copies of the latest magazines, a phonograph, billiard table, and other recreation equipment. Tennis courts have been laid out on adjacent ground. This recreation equipment has been provided at small expense and is considered money well invested.

ALASKA NORTHERN RAILROAD.

In February, 1915, the President determined to purchase the Alaska Northern Railroad if it could be obtained on reasonable terms. In April a formal contract was entered into by which the road was to be acquired for the sum of $1,150,000, much less than its original cost, and a sum within the present value of the physical properties. In June, when the season opened, control of the road was taken over, but it was not until August 25, 1915, that litigation over the title ceased and an intial installment of $500,000 (with interest) paid.

Repairs have been made to the Alaska Northern Wharf at Seward to permit the use of the terminal, and sufficient track repairs have been made to enable the running of a gasoline motor combination freight and passenger car for a distance of 34 miles from Seward,

this being about the limit of the revenue-producing region immediately adjacent to Seward. Bridges have been sufficiently strengthened for some distance beyond this point to carry light equipment. A small revenue is derived from the wharf. A temporary machine shop has been built at Seward and repairs to rolling stock are being made. A careful survey of the line is being undertaken and plans for improvement in alignment and grades are being perfected. Future harbor improvements at Seward have also been considered, but the real work of rehabilitation of the Alaska Northern can not be undertaken much earlier than the beginning of the fiscal year 1917. On July 4, 1916, the final payment of $650,000 for the Alaska Northern property is due.

TOWN SITES.

The President is authorized by the Alaskan Railroad act (38 Stat., 305)—

> to withdraw, locate, and dispose of, under such rules and regulations as he may prescribe, such area or areas of the public domain along the line or lines of such proposed railroad or railroads for town-site purposes as he may from time to time designate.

In accordance with this provision the President has by Executive orders withdrawn a number of tracts of the public domain which, by reason of their geographical location near navigable bodies of water or possible junctions of proposed railway lines, might render them of future value as town sites.

On June 19, 1915, the President issued an Executive order containing regulations for the survey of these town sites and for the sale of lots therein. (Appendix G.) These regulations prescribe that one-third of the purchase price for any lot shall be paid down and the balance in annual installments extending over a period of five years, with no taxes or interest on deferred payments. Certain restrictions are put on the lots prohibiting their use for the sale of liquor, gambling, or immoral purposes. A noncompliance with these restrictions will result in forfeiture of the lot. The regulations further provide that the Secretary of the Interior, in his discretion, may make or authorize to be made, within the town site, regulations for the improvement of streets, sidewalks, and alleys, promotion of sanitation and fire protection, the cost of such improvements to be met from special assessments levied on the lots.

Provision is also made for parks, schools, and other public purposes and for Government use.

ANCHORAGE.

Of the town-site areas withdrawn that of Anchorage (formerly known as Ship Creek) is the only one at which sales of lots have been held.

Many persons were attracted to this point in the spring of 1915 when it became known that the commission would begin construction there. These newcomers pitched tents or erected cabins on land

which would eventually be needed for railway terminal yards and buildings. It was decided to lay out a new town site on a sightly table-land about one-half mile distant. Under the direction of the General Land Office, 1,407 lots were surveyed, most of them of a size 50 by 140 feet. A liberal allowance of land for streets and alleys was made. One hundred lots were reserved for Federal and municipal purposes, schoolhouses, and parks. Under the regulations prescribed in the Executive order approved June 19, 1915, the first sale of lots took place from July 10 to 17, and was followed by other sales on August 14 and 16 and again on November 16, 17, and 18. The number of lots sold was 887, bringing a total price of $177,105; of which $60,773.55 was paid at the time of the sale.

The management of the town has been placed in the hands of the Alaskan Engineering Commission, through a town-site manager appointed by the commission. By virtue of the authority contained in the town-site regulations, the commission has cleared the land, improved the streets, and has arranged for the installation of water supply and fire protection. The cost of these public utilities will be met from special assessments levied on the lots. The commission is also arranging for the installation of telephone and electric-light systems.

A schoolhouse has been built by the commission, the school to be supported by Territorial funds.

It has been necessary for the commission to arrange for the installation of the various utilities and schools owing to the fact that as patents for the lots sold can not be granted under the regulations until the expiration of five years, it is not possible for a city government to tax or bond the real estate to provide for municipal improvements.

One of the Government physicians acts as sanitary officer for the town. About the middle of August the exodus from the older settlement to the new town began, and was accomplished in the most successful manner possible and without disorder. While a number of people have left at the approach of cold weather, it is estimated that there will be a winter population of 1,500. A school census showed about 150 children of school age.

It is felt that the Government is to be congratulated on the success of its first experiment in town building in Alaska.

SEWARD.

At Seward there has been considerable activity in building, but owing to a dispute over the ownership of a considerable portion of the property progress has been somewhat retarded. Owing to its favorable location, Seward should become a town of large importance. Immediately adjacent to the present town site on the north is a tract of Government land embracing about 60 acres. This has been laid out in large lots and streets laid out and cleared. A sale of lots will be held the coming spring, and a considerable sum should be realized.

As the railroad advances through the country, additional town sites will be platted.

MEDICAL SERVICE AND SYSTEM OF COMPENSATION FOR INJURY.

The last paragraph of the President's Executive order approved April 10, 1915, is as follows:

I charge the commission particularly with the preparation and maintenance of such arrangements as may be required for the health of the men engaged in the work of construction, and I instruct you to prepare and adopt a proper system of compensation for accidents which may occur on the work, in general on the lines of the system now in force in the construction of the Isthmian Canal, but such system shall be so framed that its benefits will be applicable not only to those who are directly in the service of the commission upon salary, but also to those who may, by contract with the commission, be actually engaged in the work of construction in Alaska.

The Secretary of the Interior issued the following instructions to the commission relative to the establishment of a system of compensation for injuries to its employees:

SYSTEM OF COMPENSATION FOR ACCIDENTS IN THE CONSTRUCTION OF RAILROADS IN ALASKA.

Pursuant to the Executive order of the President dated April 10, 1915, by which I am instructed to prepare and adopt a system of compensation for accidents which occur on the work of constructing Alaskan railways, I adopt the following system to go into effect at once and to continue in force until further orders:

Employees of the Alaskan Engineering Commission shall have the right to receive compensation for injuries sustained in the course of their employment while actually in the Territory of Alaska at the rates and in the amounts and on the conditions provided in the act entitled "An act granting to certain employees of the United States the right to receive from it compensation for injuries sustained in the course of their employment," approved May 30, 1908 (35 Stat., 556). Claims for compensation on account of injury resulting from an accident thus occurring hereafter shall be settled by the chairman of the Alaskan Engineering Commission, who shall as to all such claims, and under such regulations as he may prescribe, perform the duties which under said act are placed upon the Secretary of Labor, provided that when an injury results in death, claims for compensation on account thereof shall be filed with him within one year after such death.

And I further direct that the Alaskan Engineering Commission shall make no charge for the service of its medical or surgical officers or for medical or surgical aid furnished to any employee thus injured in Alaska, or to any person who while under contract with the Alaskan Engineering Commission is injured in Alaska, provided that at the time of such injury he be actually engaged in the work of construction of the Alaskan railways under contract with and under the supervision of the Alaskan Engineering Commission (although such person may not be an employee of the commission) and that his injury occurs in the course of and arises out of such work.

And I further direct that in case such injury of such person not an employee be such that the chairman of the commission shall deem it beneficial that he shall be conveyed to any other point in Alaska or to the city of Seattle for medical or surgical treatment not available at the place where such injury occurs, the Alaskan Engineering Commission shall pay the expense of such transportation for such purpose, when approved by the chairman of the commission.

FRANKLIN K. LANE,
Secretary of the Interior.

THE WHITE HOUSE, *July 19, 1915.*

Approved:

WOODROW WILSON.

MEDICAL SERVICE.

In accordance with the foregoing Executive and departmental orders the commission has established at Anchorage a well-equipped hospital, where men working either directly for the commission or at station work can receive medical or surgical treatment free of charge. The physicians employed by the commission make frequent trips over the work, giving treatment for such cuts, bruises, and minor ailments as do not require hospital treatment.

The employees in the vicinity of Seward and Fairbanks being very limited in numbers, all injuries have been cared for by local surgeons. Arrangements are now being made with an association which is establishing a new hospital at Seward by which injured employees will be cared for there. Similar arrangements will be made in the Fairbanks division when necessity arises.

The commission is pleased to report that the health of the men has been remarkably good, even during the congested condition at Anchorage, where a large population were temporarily living in tents and where sanitary arrangements were rather crude.

There was no epidemic of any kind. This was due mainly to the very healthful climate and also to the careful supervision of the sanitary officer provided by the commission.

COMPENSATION FOR INJURY.

A system of "compensation for injury" has also been inaugurated, applying to all men actually in the direct employ of the commission. This system provided that an employee suffering an injury extending over a period of 15 days or more is entitled to compensation, and in case of death, the dependent members of his family are entitled to a continuance of the compensation for a stated definite period. This compensation system is patterned after that administered by the Department of Labor, the chairman of the commission being the final arbiter in the case, instead of the Secretary of Labor. Full regulations governing this system are now being prepared.

LOCATION SURVEYS.

As stated elsewhere, the surveys made in 1914 were preliminary in nature, but sufficient to base an estimate on for a comparison of routes. It remained to place the final location over much of the line and stake it out on the ground. For this purpose five parties of about 20 men each were put in the field, three working south of Broad Pass and up the Matanuska River and two working north of the pass. In all, some 360 miles of location have been run. The results of the surveys have not been fully tabulated as yet, but enough has been done in that direction to show some very satisfactory results. This is especially true for certain distances along the Susitna and Nenana Rivers. The line, as projected originally, followed some high benches several hundred feet above the rivers, making very high crossings of tributary streams, which would have necessitated very expensive bridges. By a careful study of the situation it was found that the

rivers could be followed closely at a lower elevation, largely reducing these crossings. The results were especially favorable along the Nenana, where a line was found that considerably reduces the first cost of construction and will be better to maintain. South of the pass the country was not quite as favorable. A line was found, however, which, while entailing about the same cost of construction, should be more favorable to operate. A very good grade system has been established. On the Alaska Northern are two summits the approach to which from either direction requires grades of 2.2 per cent each compensated. Some slight improvement can be made in these when the traffic warrants it. Aside from these, the only place where grade over 1 per cent, compensated, is used is a short distance south of Broad Pass, where, for a distance of 14 miles, a maximum of 1.75 per cent ascending north is used, and for a distance of 3½ miles a maximum of 2.2 per cent ascending south is used. From the Matanuska coal fields to Anchorage, a maximum ascending south of 0.4 per cent is used and a 1 per cent ascending north. This is very favorable for heavy loads. From the Nenana coal fields to Fairbanks the grade is also very favorable, the maximum ascending north (against heaviest traffic) being a short piece of 0.54 per cent, the maximum ascending south being 1 per cent. This is very favorable for handling the coal. A condensed profile of line will be furnished when the result of surveys is fully tabulated.

PANAMA EQUIPMENT.

By midsummer considerable machinery and material had been overhauled and shipped from the Canal Zone to Alaska in vessels chartered for the purpose by the commission's representative. Included in the equipment and material were four "200-class" locomotives; one 70-ton and one 45-ton steam shovel; 15 flat cars of 80,000 pounds capacity each; 25 "Western" dump cars; a number of large stationary boilers; an electrical generating outfit, switchboard, and attachments; well-drilling machinery; locomotive and steam-shovel repair parts; hoisting engines; railway shop equipment, including a car-wheel boring machine, radial drill press, driving-wheel lathe, and a 30-ton drill press; and a large quantity of track and switch material and track tools.

While no charge is made for this equipment obtained from the Canal Zone, the commission bears the expense of repairs and freight. The equipment has been carefully repaired in the Balboa shops, when necessary, and is in good condition.

The saving to the commission is from 50 to 60 per cent over the cost of new equipment.

Full list of equipment given in appendix.

GENERAL DEVELOPMENT OF COUNTRY DURING 1915.

MATANUSKA VALLEY.

During the season of 1915 a number of homestead entries have been made on land in the Matanuska Valley, which will later be tapped by the railroad. The soil in this locality is very productive, but at present there is very little market for produce. The development of

the Matanuska coal fields will remedy this condition. Liberal terms should be extended to settlers in Alaska, as the expense of clearing land is large.

BROAD PASS DISTRICT.

Conflicting reports continue to come regarding alleged finds of low-grade auriferous quartz ledges. As yet no reliable information has come to the commission on which it can base estimates regarding the value of this region. It is thought, however, that there are a number of ore bodies that will be developed by a near-by railroad.

KANTISHNA DISTRICT.

A new development in this district is the commercial exploitation of high-grade antimony ore. It is understood that several hundred tons of this ore are to be sledded during the winter months to the Tanana River for early shipment via river steamer. On account of the European war antimony has attained a fictitious value which in all probability can not be maintained after the restoration of peace.

TOLOVANA DISTRICT.

This district is situated about 90 miles northwest from Fairbanks. On Livengood and its tributaries and across the divide into Mike Hess Creek there is every evidence of a future valuable mining district. A pay streak some miles in length has been located, and even under the most discouraging traffic conditions placer gold to the amount of $60,000 was taken out during the summer. The early winter has been devoted to the freighting of supplies and extensive prospecting will not be undertaken before the middle of January. One fact alone which leads to optimism regarding the district is that as yet there have been no discouraging reports regarding it. All admit that gold is there, and it now only remains to demonstrate its extent. Between 400 and 500 men are actually engaged in development work.

FAIRBANKS DISTRICT.

One of the new developments has been the discovery of antimony ore, about 1,000 tons of which were shipped during the summer. A prospect of great interest is the discovery of a ledge of 50 per cent sheelite, a very high-grade tungsten ore. The owners of the ledge during the winter expect to concentrate the ore and ship the product to Chitina, on the Copper River & Northwestern Railroad, by freight team. The European war has enhanced the value of tungsten.

NENANA COAL FIELDS.

From analyses of lignite ore close to the line of survey of the railroad, samples of which were taken this summer, the interior of Alaska is assured of a grade of fuel suitable for all domestic and commercial purposes. The ash contents are extremely low, the percentage of fixed carbon is high, and the calorific value most satisfactory. The comparison with lignite from Williston, N. Dak., from

the mine of the United States Reclamation Service, is all to the advantage of the Nenana coal.

PURCHASING OFFICE AT SEATTLE, WASH.

During the period from April 1 to December 30, 1915, there were placed by the purchasing agent at Seattle, Wash., 1,922 orders for supplies and material costing in the aggregate $915,770.70.

The more important purchases included rail and other track material, lumber for wharves, buildings, and bridges, three locomotive cranes, two switching locomotives, work-train equipment, telephone line, and the necessary commissary and subsistence supplies and forage required by the employees on construction work and location surveys.

APPENDIXES.

Appendix A.—FINANCIAL STATEMENTS.

STATEMENT No. 1.—*General financial statement, Dec. 24, 1915.*

Appropriations and repayments:		
Appropriation authorized in Alaskan Railroad act (38 Stat., 305) for "Construction and operation of railroads in Alaska," available Mar. 12, 1914		$1,000,000.00
Appropriation authorized in sundry civil appropriation act for the fiscal year 1916 (38 Stat., 861) for "Construction and operation of railroads in Alaska," available July 1, 1915		2,000,000.00
Repayments to appropriation "Construction and operation of railroads in Alaska," Mar. 12, 1914, to Dec. 24, 1915		[1] 36,915.66
Total appropriations and repayments		3,036,915.66
Disbursements:		
Disbursements and direct Treasury settlements, Mar. 12, 1914, to Jan. 31, 1915, in connection with surveying season of 1914	$392,967.81	
Deposits in United States Treasury to credit of miscellaneous recipts	[2] 359.30	
Payment of first installment of purchase price for Alaska Northern Ry., Aug. 25, 1915	504,188.49	
Disbursements on account of the several divisions from Feb. 1 to Oct. 31, 1915, inclusive, per Statements Nos. 2, 3, and 4, herein—		
Seward (headquarters) $115,659.51		
Anchorage 1,016,078.18		
Fairbanks 44,190.56		
	1,175,928.25	
Disbursements and Treasury settlements, Nov. 1 to Dec. 24, 1915, inclusive, not segregated by divisions (detailed information not received from Alaska)	801,233.47	
Total disbursements and Treasury settlements to Dec. 24, 1915, inclusive		2,874,677.32
Balance remaining to credit of appropriation, Dec. 24, 1915		[3] 162,238.34

[1] This amount of $36,915.66 does not augment the commission's appropriation, but represents deposits in the United States Treasury of amounts turned back by disbursing officers when discontinuing disbursing or taking out new bonds, refunded by transportation companies and unused portion of railway and steamship tickets, and the proceeds from sales of miscellaneous property paid for originally from the appropriation, which, under the law, are not reimbursable to the appropriation.

[2] This amount of $359.30 represents proceeds of sales of various articles, which, under the law, are not reimbursable to the appropriation.

[3] Includes some small balances to credit of disbursing officers not actually expended.

STATEMENT No. 2.—*Seward (headquarters) division—Disbursements to Oct. 31, 1915.*

Salaries and wages	$70,288.44
Subsistence and commissary	3,694.65
Passenger transportation	5,702.24
Work animals and outfits	796.29
Subsistence for work animals	3,019.00
Hospital and medical expense	18.05
Purchase, hire, and maintenance of boats	3,016.31
Office stationery and other expenses	7,034.89
Rents and storage	700.72
Furniture and fixtures	1,242.65
Camp and engineering equipment and supplies	1,318.45
Construction equipment	5,624.87
Material and supplies	12,573.94
Drayage	363.64
Shop machinery	20.12
Contract work, clearing of Seward terminal tract	245.25
Total	115,659.51

STATEMENT No. 3.—*Anchorage division—Disbursements to Oct. 31, 1915.*

Salaries and wages	$241,355.07
Commissary and subsistence	146,077.36
Redemption of coupons	346.57
Passenger transportation and travel expenses	7,536.62
Work animals and outfits	25,785.32
Subsistence and care of work animals	20,705.93
Hospital and medical expenses and supplies	1,789.10
Purchase, maintenance, operation, and hire of boats	42,088.98
Office stationery, supplies, and other expenses	3,874.37
Rents and storage	131.67
Furniture and fixtures	230.40
Camp and engineering equipment and supplies	9,443.79
Construction equipment	56,248.32
Materials and supplies	227,179.82
Contract work (clearing, grubbing, grading, cutting of ties, etc.)	212,179.80
Burial expense	150.00
Claims for damaged freight	53.08
Freight (on equipment from Panama, and local freight)	17,833.15
Drayage	105.94
Wharves and docks	1,337.50
Station and office buildings, cottages, etc	959.78
Taxes (revenue stamps)	5.00
Miscellaneous expenses, unclassified	58.61
Team hire	252.00
Miscellaneous equipment (dog team)	350.00
Total	1,016,078.18

STATEMENT No. 4.—*Fairbanks division—Disbursements to Oct. 31, 1915.*

Rent and storage	$366.67
Camp and engineering equipment and supplies, including instruments	843.19
Pack animals and outfits	1,666.01
Subsistence, pack animals	3,734.72
Picture and camera supplies	184.01
Purchase, maintenance, operation, and hire of boats	2,014.69

Subsistence and commissary	$5,952.98
Office stationery, supplies, and other expenses	195.54
Compensation account injury	126.00
Salaries and wages	21,328.18
Passenger transportation	6,598.55
Hospital service and medical attendance	296.75
Telephone and telegraph	76.75
Furniture and fixtures	51.00
Drayage	455.52
Funeral expenses	300.00
Total	44,190.56

STATEMENT No. 5.—*Appropriations available for construction of railroads in Alaska.*

PERIOD FEB. 1, 1915, TO JUNE 30, 1916.

1. Balance 1915 appropriation available Feb. 1, 1915, original appropriation of $1,000,000 authorized by Alaskan Railroad act (38 Stat., 305)	$607,095
2. Appropriation authorized in sundry civil appropriation act, for fiscal year 1917 (38 Stat., 861)	2,000,000
Total	2,607,095

PROPOSED EXPENDITURES, PERIOD MAR. 1, 1915, TO JUNE 30, 1916.

	Headquarters, Seward division.	Anchorage division.	Fairbanks division.	Total.
1. Expenses of the commission Feb. 1 to June 30, 1916	$65,052	.....	.....	$65,052
2. Headquarters office and other administrative expenses, Seward, July 1, 1915, to June 30, 1916[1]	75,000	.....	.....	75,000
3. Amount to be paid on Alaska Northern R. R., first installment of purchase price of $1,150,000	500,000	.....	.....	500,000
4. Amount necessary to expend to rejuvenate the Alaska Northern R. R. during the year 1916[2]	250,000	.....	.....	250,000
5. Location surveys, south end, 2 parties, 6 months[3]	.....	$60,000	.....	60,000
6. Location surveys, north end, 2 parties, 4 months	.....	.....	$60,000	60,000
7. Telephone line, Kern Creek to Ship Creek (Anchorage)[4]	.....	5,000	.....	5,000
8. Temporary dock, anchorage[5]	.....	12,000	.....	12,000
9. Dredging at Anchorage	.....	40,000	.....	40,000
10. Shipment of dredge and other construction equipment, Panama to Ship Creek (Anchorage)	.....	75,000	.....	75,000
11. Terminal yard, Ship Creek (Anchorage)	.....	5,000	.....	5,000
12. Machine shop and engine house (Anchorage)	.....	20,000	.....	20,000
13. Overhauling launches (Anchorage)	.....	2,500	.....	2,500
14. Ship Creek spur line, Ship Creek (Anchorage) to Ship Creek Junction	.....	125,000	.....	125,000
15. Main line, Ship Creek junction to Matanuska River	.....	1,302,643	.....	1,302,643
16. Purchasing Department, Seattle	9,900	.....	.....	9,900
Total	899,952	1,647,143	60,000	2,607,095

[1] The increase in the expenditures over the original estimate for this item is occasioned by the fact that it was found necessary to provide more dock space and provision for the berthing and repair of the floating equipment of the commission at Anchorage.

[2] It was found advisable to transfer more of the construction equipment, formerly used on the Panama Canal, than had been at first anticipated.

[3] It was found necessary to provide considerable space for the storage and assembling of the construction equipment transferred from the Canal Zone, also for the large quantities of lumber for terminal structure at Anchorage and bridges along the line of the road. More tracks were therefore laid in the Anchorage terminal yard.

[4] The commission found that they would not be able to obtain a dredge from the Canal Zone, and believing it advisable to postpone the dredging of the harbor at Anchorage until terminal facilities had been installed, it was decided to not have any dredging done in the harbor at Anchorage until next season.

[5] As already indicated in the body of this report, it was necessary for the commission to greatly increase the lighterage facilities for transferring both the commission and commercial freight from ship to shore at Anchorage. It was necessary to provide two strong and serviceable gasoline launches for distributing construction supplies and material along the line adjacent to Knik Arm. Considerable revenue is received from the lighterage of the commercial freight.

STATEMENT No. 6.—*Anchorage division—Comparison of actual expenditures to Oct. 31, 1915, with original estimates for certain items of allotment of appropriation.*

Item.	Proposed original estimate of expenditure.	Expended to Oct. 31, 1915.	Increase over original estimate.[1]	Decrease from original estimate.[1]
1. Location surveys, south end, main line, Ship Creek to Broad Pass and Matanuska coal spur	$60,000	$69,715	.....	.....
2. Wharves, docks, and marine railways, Anchorage[2]	12,000	27,793	.....	.....
3. Examination of material and foundation for dredged slip, Anchorage	.....	1,110	.....	.....
4. Shipment and repair of construction equipment, Panama to Anchorage	75,000	81,213	.....	.....
5. Terminal freight yard, Anchorage	5,000	67,841	$17,841	.....
6. Machine shops, engine house, and other permanent buildings, Anchorage	20,000	15,435	.....	.....
7. Dredging at Anchorage	40,000	.....	.....	.....
8. Cost of lighters, scows, pontoons, stern-wheel boats, small boats, and all floating equipment, Anchorage	2,500	63,657	61,157	.....
9. Temporary telephone line, Kern Creek to Anchorage	5,000	6,931	1,931	.....
10. Cost of construction of Ship Creek spur line	125,000	91,385	.....	$33,615
11. Cost of construction of main line, Ship Creek junction to Matanuska River $645,241	1,302,643	645,241	.....	.....
Estimated cost to complete 485,240	.....	.....	.....	.....
Total approximate cost, from latest available figures 1,130,481	.....	.....	.....	[3] 172,162
12. Winter quarters for permanent employees[2]	.....	25,655	.....	.....
13. Winter quarters for permanent employees[2]	.....	.....	.....	.....
14. Wintering live stock[2]	.....	3,691	.....	.....
15. Construction work account new town site, Anchorage[2]	.....	35,032	.....	.....
16. Maintenance of hospital, Anchorage[2]	.....	10,292	.....	.....
17. Expenses of post office, Anchorage[2]	.....	1,803	.....	.....
18. Cost of marshal's office, Anchorage[2]	.....	2,006	.....	.....
19. Construction of winter trail, Anchorage to Bird Point[2]	.....	952	.....	1,108
20. Cost of schoolhouse, Anchorage[2]	.....	3,012	12	.....
21. Cost of commercial telephone system, Anchorage[2]	.....	2,764	.....	.....

[1] Where figures are not extended in the increase or decrease columns, the item has either not been completed or detailed figures have not been received from the field.
[2] For items Nos. 2 and 12 to 21, inclusive, no original estimates were made.
[3] Estimated.

STATEMENT No. 7.—*Comparison of actual expenditures to Oct. 31, 1915, with original estimates for certain items of allotment of appropriation.*

Item.	Proposed original estimate of expenditure.	Amount expended.	Date.
SEWARD (HEADQUARTERS) DIVISION.			
1. Expense of the commission. Feb. 1 to June 30, 1915	$65,052.00	.....	
2. Headquarters office and other administrative expenses, Seward, July 1, 1915, to June 30, 1916.	75,000.00	$76,700.00	To Nov. 13, 1915.
	140,052.00		
3. First installment of purchase price of $1,150,000 for Alaska Northern Ry.	500,000.00	504,188.49	To Aug. 25, 1915.[1]
4. Amount necessary to expend to rejuvenate the Alaska Northern Ry. during fiscal year 1916.	50,000.00	[2] 60,700.00	To Nov. 13, 1915.
5. Purchasing department, Seattle, Wash., including office rental.	9,900.00	12,100.00	To Nov. 13, 1915.[3]
FAIRBANKS DIVISION.			
1. Location surveys, north end, two parties	60,000.00	46,793.50	To Dec. 31, 1915.[4]

[1] Includes $4,188.49 interest.
[2] From appropriation, 1916, $49,000; from earnings, $11,700.
[3] Owing to the large volume of purchases necessary to be made within a few months, it was found necessary to slightly increase the force in the purchasing office at Seattle, Wash., and there was a consequent increase for equipment and running expenses.
[4] Estimated expenditures to June 30, 1916, $14,000.

Appendix B.—INFORMATION REGARDING SPECIFICATIONS FOR CONSTRUCTION CONTRACTS.

GENERAL CONDITIONS.

The work is to be commenced at such points and to be carried on to completion with such rate of progress by the contractor as the commission from time to time directs, and the entire work contemplated under the agreement to be entirely completed within the time specified in the contract.

Grading.—Under this head will be included all cuts and borrow pits, and excavations for foundations of masonry and timber bridges, and timber or log culverts, and all other structures (if not under water to require bailing or pumping), and all surface ditches, ditches for diversion of streams, wagon-road changes, and wagon and farm road crossings, and side tracks and spur tracks, and grading of station grounds, and all other grading shall be made as specified by the engineer, and shall be paid for at the prices named for the main excavations, unless otherwise specified.

When practicable, quantities paid for shall be measured by the cubic yard in excavation of cuts and borrow pits and calculations of quantities made by prismoidal formula or methods based thereon. When not practicable to so measure borrowed material for embankments, the measurement thereof shall be by prism measurement of the embankments as directed to be constructed, said direction to be by stakes set and marked by the engineer at profile (or formation) grade for roadbed widths herein specified or for extra width of top of roadbed embankments, per specifications or for allowance for extra height of roadbed embankments to provide for expected settlement, all as shall be considered by the engineer to be suitable; and from said stakes defining the top of the embankments an uniform slope of one and one-half (1½) horizontal to one (1) vertical shall be assumed to run to intersect the ground surface, but with such deductions from or additions to the prism measurement obtained as hereinbefore specified, on account of swelling or shrinkage of borrowed material or of material hauled from cuts into embankments as may be deemed just by the engineer.

Material will be classified under the following heads:

CLASSIFICATION OF EXCAVATION.

Loose rock.—Including small boulders and fragmentary rock which does not form part of a rock ledge and which are loose on the ground surface, or which are enclosed by any or all of the material included in the "common" classification, and which boulders and fragmentary rock shall be in pieces containing not less than one (1) cubic foot and containing less than nine (9) cubic feet. Also all slate or other rock that can be quarried without blasting, although blasting may be occasionally resorted to. Also all cemented materials, including any and all materials in the "common" and "loose-rock" classifications cemented and bound together by a silicious or other cementing matrix, which matrix is of a character to remain unchanged, whether dry or moist or saturated with moisture. Clay, sand, gravel, or mixtures of these materials without the additional silicious or other cementing matrix of the materials hereinbefore described will not be classed as cemented material; also, soft clay shale shall be classified as loose rock.

Solid rock.—All rock of the character of a rock ledge or formation, including hard or silicated clay shale, quartzite, serpentine, conglomerate, sandstone, and volcanic formations resembling sandstone, graywacke, and boulders containing more than nine (9) cubic feet and slate which can not be removed without blasting.

Common.—All other material not included in the hereinbefore specifications and which other materials, for convenience, will be called "common," and including ordinary soils, clay, adobe, sand, gravel, volcanic ash, which is of an earthy character, not cemented or metamorphosed, and all other materials of an earthy nature, and cobble, fragmentary rock which does not form part of a rock ledge and which is loose on the ground surface and which is enclosed by any or all of the materials hereinbefore mentioned, and which cobble, or small boulders, or fragmentary rock shall be in pieces containing less than one (1) cubic foot.

All material taken from cuts shall be deposited in the embankments within the distance prescribed by the engineer.

It shall be optional with the engineer to allow the contractor to waste material from cuts and construct embankments from borrowed material in lieu of same, but in such cases the work shall be estimated the same as if the material had been hauled from excavation to embankment as above contemplated and within the distance prescribed and limited by the engineer.

The price paid for "excavation" in all the several classes hereinbefore mentioned will be understood to cover and pay for the entire expense of its removal by any method whatever, including loading, unloading, transportation, and deposit in the manner prescribed in these specifications, in the places designated by the engineer, provided the haul of the materials so transported does not exceed four hundred (400') feet, and beyond that distance one cent per cubic yard per one hundred (100') feet will be allowed and paid for such extra haul in addition to the price paid for excavation.

GENERAL SPECIFICATIONS FOR GRADING.

The center of the roadbed shall conform accurately to the center line of the railroad as staked out or otherwise indicated on the ground and to the proper curvature and grades as described and defined by the engineer, and the contractor shall make such deviations from these lines and grades as the engineer may require.

The single-track roadbed in excavation shall be of the uniform width of eighteen (18) feet at profile grade, unless otherwise directed by the engineer, and the single-track roadbed or embankments shall be of uniform width of sixteen (16) feet at profile grade, unless otherwise directed by the engineer, and shall be finished to a true and even surface and to conform to the grades set by the engineer.

The line of road or the gradients or width of roadbed may be changed if the engineer shall consider such changes necessary or expedient; and for any considerable alterations resulting in injury to the contractor, the amount of injury will be estimated by the engineer and such allowance made in the prices as the engineer may deem just and equitable; but no claim for an increase in prices will be allowed unless made before the work in that part of the section where the alteration has been made shall have been commenced.

Any material from cuts which is suitable for riprap shall be reserved for that purpose when directed by the engineer, and shall be deposited at some point on the side of the road designated by the engineer.

Cuts shall be taken out to such slopes as the engineer may direct. Embankments shall be built to a uniform slope of one and one-half (1½) feet horizontal to one (1) foot vertical, unless when desired to vary the same; and in all cases the slopes shall be built as the engineer may direct.

Ditches shall be excavated through cuts as may be directed.

Where embankments are constructed from material taken from ground adjacent to and opposite them, a berm of not less than ten (10) feet nor more than fifty (50) feet shall be left outside the slopes of such embankments as may be directed by the engineer.

All borrow pits will be excavated in a regular manner and so as to leave no holes for standing water. When necessary for the purpose of drainage, borrow pits shall be made continuous and shall be excavated to such grades and dimensions as the engineer may direct. Material taken from borrow pits shall be classified as in regular excavation. Whenever the excavations furnish more material than is required for embankment, the surplus will be used to increase width of embankment or deposited in spoil banks or waste piles as and where the engineer may direct.

In case of slides or "overbreak," the engineer shall determine if the same were occasioned by natural causes; and if so, payment shall be made for same at regular contract price. If caused by excessive use of explosives, no payment shall be made for same, and contractor shall remove all such material at his own cost and expense. Over culverts and behind bridge abutments the embankments shall be formed carefully, so as to avoid damage to the structure. The contractor will be held responsible for any such damage.

All embankments shall be built with a half width in excess of the standard half width specified of five per cent (5%) of the vertical height from each slope stake to profile grade.

The contractors shall give notice to the engineer in writing at least two days before it is desired to open a borrow pit of their intention to do so, and of the position of the borrow pit desired to be opened, in order that the engineer may cross-section the borrow pit before the work of excavation therefrom begins.

SPECIFICATIONS FOR CLEARING RIGHT OF WAY.

1. The whole or as much of the right of way as the engineer may direct shall be entirely cleared of all trees, logs, brush, and other perishable matter, all of which shall be burnt or otherwise disposed of as the engineer may direct, unless specially reserved to be made into ties, timber, or cordwood. Unless directed in writing by the engineer, trees and brush must not be thrown on adjacent lands, but must be disposed of on the right of way. Trees unavoidably falling outside right of way must be cut up, removed to right of way, and disposed of.

All trees, stumps, undergrowth, and brush within such clearing must be cut so that tops of same shall not be over eighteen inches above surface of ground.

No allowance will be made for the cutting and removal of grain, grass, woods, or other annual plants on the right of way, the contract price of grading being assumed and understood to cover all such items.

2. All trees outside the limit of the right of way, considered unsafe by the engineer, shall be cut down and disposed of as other clearing; but no trees shall be cut down unless marked for cutting by the engineer.

3. Clearing shall be paid for by the acre where actually performed; and dangerous trees cut outside the right of way, at the specified rate per single tree.

4. Any trees or logs reserved to be made into ties, timber, or cordwood under the provisions of par. 1, shall be neatly piled upon the right of way as the engineer may direct; the price paid for clearing to cover this work.

SPECIFICATIONS FOR GRUBBING.

1. Stumps shall be grubbed entirely from all places where excavations occur, including ground from which the material is to be borrowed as well as from ditches, new channels for waterways, between the slope stakes of all embankments of less than two feet in height, and from other places when required.

2. Grubbing will be estimated and paid for by the acre only when actually performed in excavation less than four feet deep, under embankments less than two feet high, and in borrow pits, ditches, drains, and new channels for water within the clearing limits; no grubbing will be allowed on the slopes of any cutting where the depth at a distance of eleven feet on either side of the center line exceeds four feet.

GENERAL CONDITIONS.

Whenever the line of the railroad is traversed by public or private roads, good and sufficient passing places must be kept open and in safe condition for use at the expense of the contractor.

In building through farms or ranches, such temporary fences as will be necessary for the proper protection of crops must be kept up by the contractor.

Whenever necessary stakes will be placed to define the limits of the right of way. Any claims for damages arising from trespass or injury to property outside the limits indicated by these stakes must be settled at the expense of the contractor.

All material and workmanship to be to the satisfaction of the engineer whose decision will be final in all matters affected by the contract which may be in dispute between the commission and the contractor.

The engineer herein referred to is the chief engineer of the Alaskan Engineering Commission, or his duly authorized assistants.

Should the commission, at any time, become dissatisfied with the rapidity or the manner of the prosecution of the work to be done under this contract, or the quality of the workmanship of the contractor (the chief engineer to be sole judge thereof) and if the contractor shall fail, neglect, or refuse, when requested to do so, to remove the cause of such dissatisfaction, the commission may, at its option, on giving twenty-four hours' notice in writing of intention so to do, remove the contractor from the work and the contract shall be considered as null and void and settlement made only for the completed portion of the work, less the retained percentage and other charges as hereinbefore provided.

It is understood and agreed that the contractor shall hold the commission harmless and free from all liability for all injuries to any person or persons, either members of the contracting firm or any outside party or parties, or any and all damage to property owned by the contractor or any person or persons, caused in any way by the contractor or his agents, and all damages or liability

and judgments, costs, expenses and attorneys' fees arising or to arise from any of these causes.

The contractor shall be subject to the laws of the Territory of Alaska regarding liens for material furnished for said work, and shall protect or indemnify the commission against all claims or liens against the work for material furnished said contractor.

_____
Commissioner.

Approved:

_____
Chairman Alaskan Engineering Commission.

Appendix C.—PROPOSAL FOR STATION WORK.

_____, 191__.

To the ALASKAN ENGINEERING COMMISSION,

_____

We, the undersigned, constituting and forming a partnership, to be known by the name of _____ for the purpose of the work covered in this proposal and for everything incident thereto, either directly or indirectly, the act of each to bind the others, hereby submit a proposal to do the following described work for the Alaskan Engineering Commission, governing ourselves at all times by the following conditions, obligations, and agreements, to wit:

1. We propose and hereby agree to execute, construct, and finish in every respect and in the most substantial and workmanlike manner all the clearing work on that part of the located line, in the Territory of Alaska, now being constructed by the Alaskan Engineering Commission, under and in strict accordance with the adopted standard specifications and directions of the engineer for the Alaskan Engineering Commission, between stations _____ and _____, for the sum of _____.

2. We agree, in case of acceptance of this proposal, to commence and diligently prosecute the said work with such means as will, in the opinion of the engineer of the Alaskan Engineering Commission, insure the completion of the same on or before the ____ day of _____, 191__. And further, that if, in the opinion and judgment of the engineer in charge of said work, we are unable, from any cause, to carry on the work, or make default in the due performance of the contract, or fail in making satisfactory progress with the work through any of our number refusing to work, or delaying the work, or shall neglect or refuse to comply with any of the instructions or directions of the engineer in charge, and if, upon the engineer giving notice in writing of such delay, specifying the same, the members of the said partnership do not within _____ hours after said notice is handed to any member of the partnership or by posting of such notice at the place where said work was to have been performed, proceed with the work to the entire satisfaction of the engineer in charge, then the contract shall be considered null and void and a settlement will be made only for the actual completed portion of the work, and from this settlement will be deducted all charges for supplies, rentals, personal board and commissary accounts and other proper charges to date.

3. We agree to take in new partners (if such new partners are satisfactory to the engineer in charge) in place of those who retire from the contract, and that number of partners actively engaged on the work shall at no time fall below _____. In the case of any member retiring from the contract before the completion thereof, the retiring partner hereby agrees to waive all right, title, and interest whatsoever in said contract. If, upon completion of the contract, for any just reasons, it is decided to reimburse the retiring stationman or stationmen for labor performed, the retiring partner hereby agees, absolutely, to accept whatever method of payment as is decided by the remaining members and approved by the Alaskan Engineering Commission.

4. The Alaskan Engineering Commission agrees to permit the members of the station gang to take in additional partners if in the interest of the Government to do so.

5. We agree to perform the said work by labor only of partners in this contract, and that no other labor is to be employed by us on said work except as approved by the Alaskan Engineering Commission. If stationmen are authorized by the commission to hire laborers, the rate paid these laborers must be

in accordance with standard schedule of wages adopted by the commission. The law in regard to the service and employment of all laborers who may be employed by any station gang upon any of the public works of the Government of the United States is limited and restricted to eight hours in any one calendar day, and it shall be unlawful for any station gang which has power to employ, direct, or control the services of such laborers to require or permit any such laborers to work more than eight hours in any calendar day, except in case of emergency. The penalty stipulated for the violation of the provisions of the law governing labor is five dollars for each laborer for each calendar day in which he shall be required to work or be permitted to work more than eight hours upon the work herein contracted. We, the stationmen, hereby agree to accept this provision in regard to hired labor as a part of the conditions under which the Alaskan Engineering Commission will accept this proposal.

6. The Alaskan Engineering Commission will furnish the members of this station gang, at reasonable prices, with necessary tools, power, and supplies for the efficient prosecution of the work, as long as the work is proceeding to the satisfaction of the engineer in charge, and shall charge the same to the account of the partnership. The Alaskan Engineering Commission, at their option, will, upon completion of the said work, take over tools, etc., that are in good condition, at a fair valuation, such valuation to be fixed by the said Alaskan Engineering Commission.

7. The Alaskan Engineering Commission will furnish and will be entitled to charge the account of said partnership for outfit and team rentals as follows:

Horses and harness _____ $3 per horse per day, with feed.

The partnership will be held responsible for any pay for all damages whatsoever claimable in respect to any injury to property belonging to the Alaskan Engineering Commission.

8. And the Alaskan Engineering Commission, in consideration of the fulfilment and performance of all the stipulations contained in this proposal, and whenever said work shall be completed, finished, and performed agreeably to the various stipulations and specifications hereinbefore referred to, and whenever the engineer in charge shall furnish a certificate of the satisfactory completion of the work, together with an estimate of the various kinds of work done, which estimate shall be final, will pay the station men the amount found to be due under this contract.

9. No officer or employee of the United States shall have any personal or private interest in the subject matter of the proposal or acceptance herein; and no Member or Delegate to Congress shall be admitted to any share or part of this contract or agreement or to any benefit to arise therefrom.

Approved:

_____,
Commissioner.

_____.
_____.

Appendix D.—PROPOSAL FOR FURNISHING RAILROAD TIES.

No. ____.

ANCHORAGE, ALASKA,
(Date) _____

To the ALASKAN ENGINEERING COMMISSION,
Anchorage, Alaska.

We, the undersigned, constituting and forming a partnership, to be known by the name of _____,
for the purpose of furnishing and delivering railroad ties and for everything incident thereto, either directly or indirectly, the act of each to bind the others, hereby submit a proposal to furnish and deliver to the Alaskan Engineering Commission, in accordance with the advertisement for same, dated May 22, 1915, railroad crossties, as follows:

(Number) _____
Firsts, $_____ each for spruce; $_____ each for hemlock.
Seconds, $_____ each for spruce; $_____ each for hemlock.
Delivery to be made at _____,
by _____. The ties will be cut in the following locality:

_____.

1. We agree, in case of acceptance of this proposal, to commence and diligently prosecute the delivery of said ties with such means as will, in the opinion of

the engineer of the Alaskan Engineering Commission, insure their delivery on or before the time specified, and further if, in the opinion and judgment of the engineer in charge, deliveries can not be made by and at the time specified, then and in that case, after due notice has been handed to any member of the partnership or posted at the points where deliveries are to be made, this contract shall become null and void _____ hours after such notice has been given, and settlement shall be made for actual deliveries only.

2. We agree to furnish our own tools and supplies for use in cutting and delivering said ties.

3. We agree to comply with the following requirements and regulations of the national forest:

A. To cut only such timber as is described in this permit.

B. To conduct the cutting and dispose of the slash and refuse as directed by the forest officer.

C. All material available in the judgment of the forest officer suitable for the purpose described shall be cut from the described area unless not required by the forest officer.

D. To sell none of the material taken except to the Alaskan Engineering Commission.

E. To assist forest officers to fight fire while this permit is in effect without pay if the area covered by this permit is on fire or is threatened by fire in the judgment of the forest officer, otherwise at the rate of pay prevailing on the Chugach National Forest.

F. To comply with all other regulations governing the national forest.

G. Settlement under this contract will not be made until the area is examined by the forest officer and found in a satisfactory condition.

H. Forest officer should be notified a few days in advance of completing cutting on any area so that there will be no delay in accomplishing settlement.

4. The partnership will be held responsible for and pay all damages whatsoever claimable in respect of any injury to property belonging to the Alaskan Engineering Commission.

5. And the Alaskan Engineering Commission, in consideration of the fulfillment and performance of all the stipulations contained in this proposal, and whenever the engineer in charge shall furnish a certificate showing the number, kind, and quality of ties delivered under this contract, will pay the partnership the amount due under this contract.

6. No officer or employee of the United States shall have any personal or private interest in the subject matter of the proposal or acceptance herein; and no Member of or Delegate to Congress shall be admitted to any share or part of this contract or agreement, or to any benefit to arise therefrom.

By _____

Approved:

_____,
Commissioner.

Appendix E.—CONTRACT.

This agreement, made this ____ day of _____, 191__, between the Alaskan Engineering Commission, by _____, duly authorized by said commission, and _____, hereinafter designated as the contractor.

Witnesseth, that the parties covenant and agree that:

ARTICLE 1. The contractor will furnish and deliver _____, in accordance with attached proposal and specifications, which are made a part hereof.

ARTICLE 2. In consideration of such full performance the contractor shall be paid as in such proposal and specifications, provided, however, that payments for partial deliveries may, at the discretion of the Alaskan Engineering Commission, be made from time to time.

ARTICLE 3. No interest in this agreement shall be transferred to any other party without the consent of the Alaskan Engineering Commission.

ARTICLE 4. Said deliveries of _____ shall commence no later than _____, 191__, and full and final deliveries be made on or before _____.

In agreement hereto the undersigned have hereunto set our hands and seals this ____ day of ----------, 191__.

----------,
Contractor.

----------.

Witness to all signatures:

----------.

----------.

----------,
Superintendent of Construction.

Approved:

----------,
Commissioner.

Appendix F.—LIST OF EQUIPMENT RECEIVED FROM THE PANAMA CANAL, 1915.

	Number.
Oswego—150-horsepower boilers for pumping plant	4
Clam-shell bucket	1
80,000-capacity wooden flats	15
Drill steel	Large amount.
Well drills	12
Complete sets well-drill tools	24
Three-drum hoisting engine and boiler	1
Two-drum hoisting engine	1
200-class locomotives	4
Moonbeam drivers, including boilers for engine; iron, but no wooden parts for moonbeam drivers	2
Pumps	6
70-ton steam shovel	1
45-ton steam shovel	1
Additional pile-driver hammer	1
Horizontal boilers	2
Car-wheel boring machine	1
Radical drill press	1
Pipe cutter and threader	1
Bolt cutter	1
3-spindle woodworker's boring machine	1
Axle lathe	1
Driving-wheel lathe	1
Pipe-threading machine	1
30-ton wheel press	1
75-kilowatt 150-volt Westinghouse machines	2
Slotter	1
Boiler clamp	1
Bed plane	1
Cincinnati planer	1
Forming slabs	2
Air compressor	1
Gib cranes for shops	2
Blacksmith forge	1
Switchboard	1
35-horsepower 100-volt motors	2
220-volt 8-kilowatt generator set	1
Barrels porcelain tubes	2
Barrel porcelain cleats	1
Worthington duplex pumps	2
Office safes	6
Air receiving drum	1
Grindstone	1
Locomotive air pumper	1
Repair parts for locomotives and steam shovels.	
Tie plates (tons)	405

MEMORANDUM CERTIFICATE TO SUCCESSFUL BIDDER.

_____, ALASKA,
_____, 19__.

This is to certify that _____,
post-office address _____,
has been declared the successful bidder for lot No. _____, block No. _____,
in the town site of _____,
Alaska, and is entitled to purchase said lot. The amount of his bid was _____ dollars ($_____).

_____,
Superintendent of Sale.

NOTE TO BIDDER.—This memorandum certificate must be surrendered to the superintendent of sale before the close of the next succeeding sale day, or the next business day if bid accepted on the last sale day, together with application to purchase the lot described, accompanied by the cash payment required by the regulations governing the sale, or all rights under the bid will be forfeited.

Serial No._____
Receipt No._____

APPLICATION TO PURCHASE TOWN LOT.

(To be executed in duplicate.)

DEPARTMENT OF THE INTERIOR,
UNITED STATES LAND OFFICE,
_____ALASKA.

I, _____
post-office address_____
having been declared the successful bidder for Lot No._____, Block No._____,
in the town site of _____, Alaska, as delineated and designated on the approved plat thereof, containing _____ square feet, do hereby apply to purchase said lot, subject to all the regulations governing the sale thereof, and agree to pay therefor the amount bid by me, viz, _____ dollars ($_____), on the following terms, to wit, one-third cash, which is tendered herewith, and the balance in five equal annual installments, payable in one, two, three, four, and five years, respectively, from the date register's certificate of sale issues hereunder; upon failure to pay any installment on or before the day the same becomes due, all rights under this application, together with the payments theretofore made, may be forfeited by the Secretary of the Interior.

I further agree that if the said lot, or any part thereof, shall be used for the purpose of manufacturing, selling, or otherwise disposing of intoxicating liquors as a beverage, or for gambling, prostitution, or any unlawful purpose, at any time during a period of five years from the date of register's certificate of sale, and prior to the issuance of certificate of final entry, or if, at any time during said period, I or my successors in interest under this application, shall fail to comply with any regulation or requirement which the Secretary of the Interior, in his discretion, shall make or authorize to be made, for the improvement of streets, sidewalks, and alleys, promotion of sanitation, and fire protection within said town site, then all rights under this application shall terminate and a forfeiture thereof, together with the payments theretofore made, may be declared by the Secretary of the Interior, whose finding of fact shall be final.

_____
(Sign here, full Christian name.)

I hereby certify that the foregoing application and agreement was signed and acknowledged before me this ____ day of _____, 19__, at _____.

_____
(Official designation of officer.)

(NOTE.—No sum less than twenty-five dollars (25.00) will be received as the first cash payment, and if one-third the amount bid is less than that sum, proper modification should be made in the above terms of sale relating to payment.)